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RADIOLOGICAL HEALTH DATA

QUARTERLY REPORT

January 1961

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

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JANUARY 1961

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Division of Radiological Health

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. The Department delegated this responsibility to the Division of Radiological Health, Public Health Service.

Radiological Health Data is published by the Public Health Service on a monthly basis. Data is provided to the Division of Radiological Health by other Federal agencies, State health departments, and by foreign governments. Except where material is directly quoted, summaries are prepared by the staff of the Division of Radiological Health. The reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

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PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout from nuclear weapons tests. Although no nuclear tests have been conducted by the United States since 1958, the program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 45 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 stations operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to a laboratory in Washington, D. C., for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 45 stations on an average of 70 percent of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85 percent of the stations collect samples of precipitation which are sent to Washington, D. C., for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table 1 presents a summary of the latest monthly data on gross beta radioactivity. Table 2 presents daily measurements of radon, thoron, and gross beta activity at the Network's Cincinnati, Ohio station.

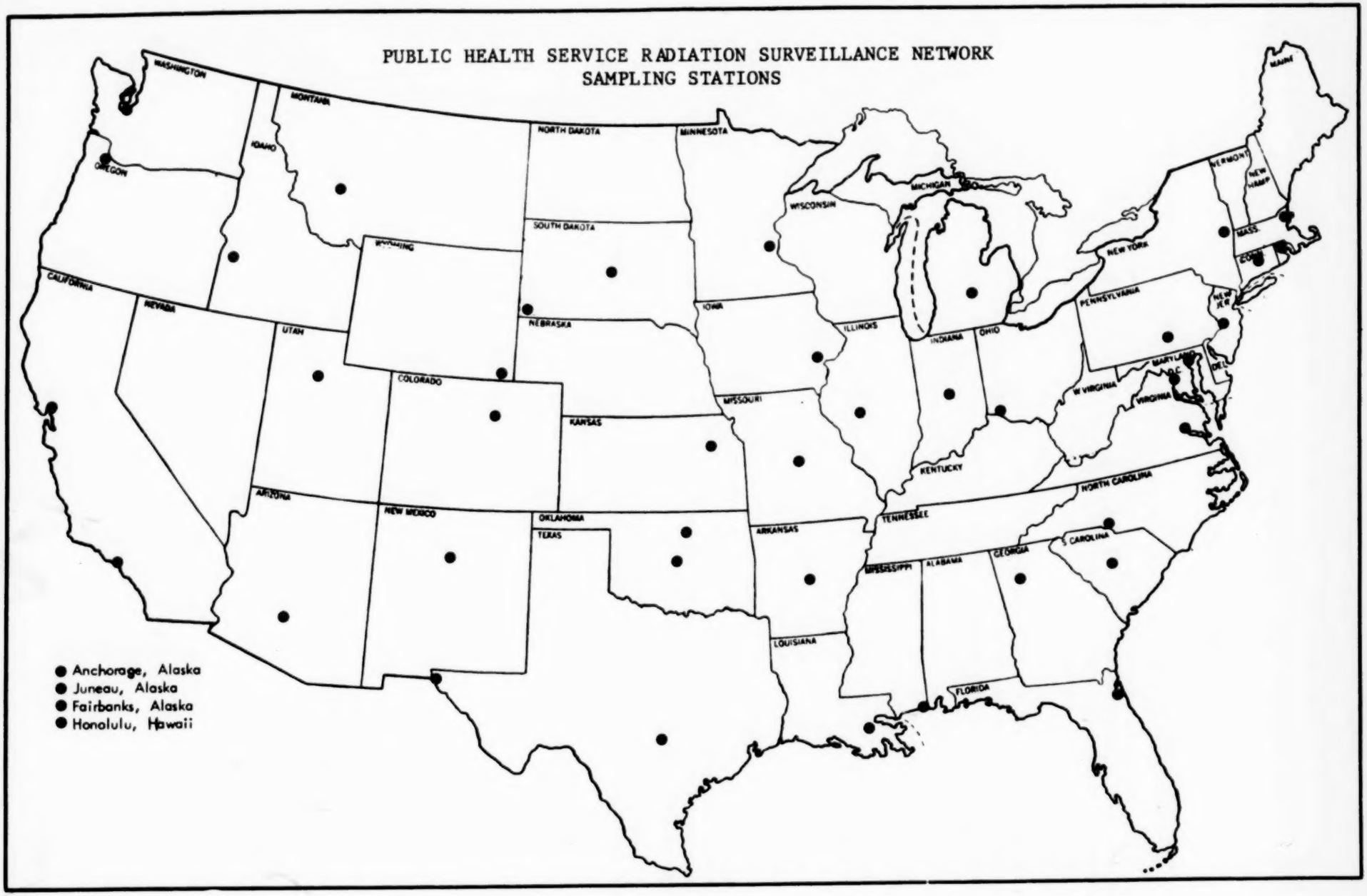

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK
SAMPLING STATIONS
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
VERMONT
NEW HAMP.
MASS.
CONN.
R.I.
N.J.
MARYLAND
D.C.
DEL.
Anchorage, Alaska
Juneau, Alaska
Fairbanks, Alaska
Honolulu, Hawaii

FIGURE 1

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR—GROSS BETA COUNTS

Public Health Service Radiation Surveillance Network

August 1960

Station location	Weighted average $\mu\mu c/m^3$	Maximum $\mu\mu c/m^3$	Minimum $\mu\mu c/m^3$
Alaska, Anchorage	< 0.10	< 0.10	< 0.10
Alaska, Fairbanks	< 0.10	0.12	< 0.10
Alaska, Juneau	< 0.10	< 0.10	< 0.10
Arizona, Phoenix	< 0.10	0.12	< 0.10
Arkansas, Little Rock	< 0.11	0.16	< 0.10
California, Berkeley	< 0.10	< 0.10	< 0.10
California, Los Angeles	< 0.10	0.12	< 0.10
Colorado, Denver	< 0.12	0.17	< 0.10
Connecticut, Hartford	< 0.11	0.22	< 0.10
District of Columbia	< 0.12	0.21	< 0.10
Florida, Jacksonville	< 0.10	0.11	< 0.10
Georgia, Atlanta	0.08	0.19	0.02
Hawaii, Honolulu	< 0.10	< 0.10	< 0.10
Idaho, Boise	< 0.12	0.19	< 0.10
Illinois, Springfield	< 0.17	0.26	< 0.10
Indiana, Indianapolis	< 0.11	0.20	< 0.10
Iowa, Iowa City	< 0.13	0.18	< 0.10
Kansas, Topeka	< 0.11	0.15	< 0.10
Louisiana, New Orleans	< 0.10	0.10	< 0.10
Maryland, Baltimore	< 0.11	0.17	< 0.10
Massachusetts, Lawrence	< 0.10	0.13	< 0.10
Michigan, Lansing	< 0.11	0.22	< 0.10
Minnesota, Minneapolis	< 0.11	0.13	< 0.10
Mississippi, Pascagoula	< 0.11	0.18	< 0.10
Missouri, Jefferson City	< 0.11	0.16	< 0.10
Montana, Helena	< 0.11	0.16	< 0.10
New Jersey, Trenton	< 0.16	0.38	< 0.10
New Mexico, Santa Fe	< 0.12	0.17	< 0.10
New York, Albany	< 0.11	0.20	< 0.10
North Carolina, Gastonia	< 0.11	0.15	< 0.10
Oklahoma, Oklahoma City	< 0.11	0.16	< 0.10
Oklahoma, Ponca City	< 0.10	< 0.10	< 0.10
Oregon, Portland	< 0.10	0.21	< 0.10
Pennsylvania, Harrisburg	< 0.12	0.22	< 0.10
Rhode Island, Providence	< 0.12	0.18	< 0.10
South Carolina, Columbia	< 0.10	0.10	< 0.10
South Dakota, Edgemont	-	-	
South Dakota, Pierre	< 0.13	0.16	< 0.10
Texas, Austin	< 0.10	< 0.10	< 0.10
Texas, El Paso	< 0.12	0.16	< 0.10
Utah, Salt Lake City	< 0.12	0.34	< 0.10
Virginia, Richmond	< 0.11	0.13	< 0.10
Washington, Seattle	< 0.10	< 0.10	< 0.10
Wyoming, Cheyenne	< 0.10	0.10	< 0.10

TABLE 2.--RADON AND THORON MEASUREMENTS

Public Health Service Radiation Surveillance Network Station at Cincinnati, Ohio

August 1960

Date	Continuous sample collection			Radon[a] AM $\mu\mu c/m^3$	Radon[b] PM $\mu\mu c/m^3$	Thoron[c] $\mu\mu c/m^3$	Beta[d] activity $\mu\mu c/m^3$
	Sample change time	Sampling period (hours)	Volume m^3				
August 1	0820	72.0	82.5	467	155	6.2	0.9
2	0820	23.9	27.8	868	191	9.8	3.5
3	0825	24.0	27.5	382	214	6.5	2.2
4	0825	23.9	29.0	228	184	4.8	2.1
5	0815	23.8	28.8	842	148	9.5	0.1 (3)
8	0825	72.2	85.8	327	148	4.7	0.8
9	0825	24.0	29.1	665	256	7.4	2.7
10	0825	23.9	29.0	371	156	2.2	0.9
11	0820	23.8	29.1	426	135	2.8	1.2
12	0815	23.8	28.8	814	138	3.5	0.1 (3)
15	0820	71.9	86.7	310	249	3.8	0.8
16	0820	23.9	29.4	249	170	2.4	1.0
17	0830	24.1	29.2	627	183	5.1	3.2
18	0825	23.8	29.1	660	143	6.1	3.9
19	0800	23.1	28.0	665	220	6.6	0.4 (3)
22	0830	72.4	88.6	411	157	3.0	0.6
23	0825	23.8	29.0	527	98	3.8	2.3
24	0813	22.5	25.8	506	99	3.9	2.4
25	0830	24.2	27.2	565	134	5.5	1.4
26	0820	23.3	28.0	761	133	7.5	0.3 (3)
29	0825	72.0	86.4	304	92	7.5	1.1
30	0815	23.8	29.3	394	93	4.8	2.2
31	0807	23.8	29.0	435	162	3.7	2.0
	Average			580	159	5.7	1.2

(a) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(b) Filters are temporarily withdrawn from sampler at about 3 p.m. and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 a.m. the following day.

(c) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

(d) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis. This activity is due principally to thoron except when counted after 3 or more days.

PUBLIC HEALTH SERVICE NATIONAL AIR SAMPLING NETWORK

The Public Health Service developed its National Air Sampling Network in 1953 to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, climate, and other factors associated with air quality.

The current basic network consists of 103 sampling statins operating every year in 66 large cities and 37 nonurban areas. In addition to these every-year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Netowrk Stations appeared in the May 1960 issue of Radiological Health Data.

The Network stations are manned by cooperating federal, state, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2000 cubic meters of air are collected on glass fiber filters on a bi-weekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

Quarterly reports of individual sample data and annual summaries are distributed to all participating agencies and state health departments. A comprehensive report on the first five years of operation of the Network is contained in the publication, Air Pollution Measurements of the National Air Sampling Network, Public Health Service Publication No. 637, 1958; for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price $2.00. Gross beta activity, by States, for the years 1953 through 1958 was submitted by Dr. F. J. Weber, Chief of the Division of Radiological Health, Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 173-185.

The 1959 quarterly and yearly averages of the gross beta activity of particulates in air were published in the October 1960 Radiological Health Data, and the first and second quarterly averages for 1960 gross beta activity of particulates in air were published in the November issue. Table 1, which follows, presents the third quarterly averages for 1960.

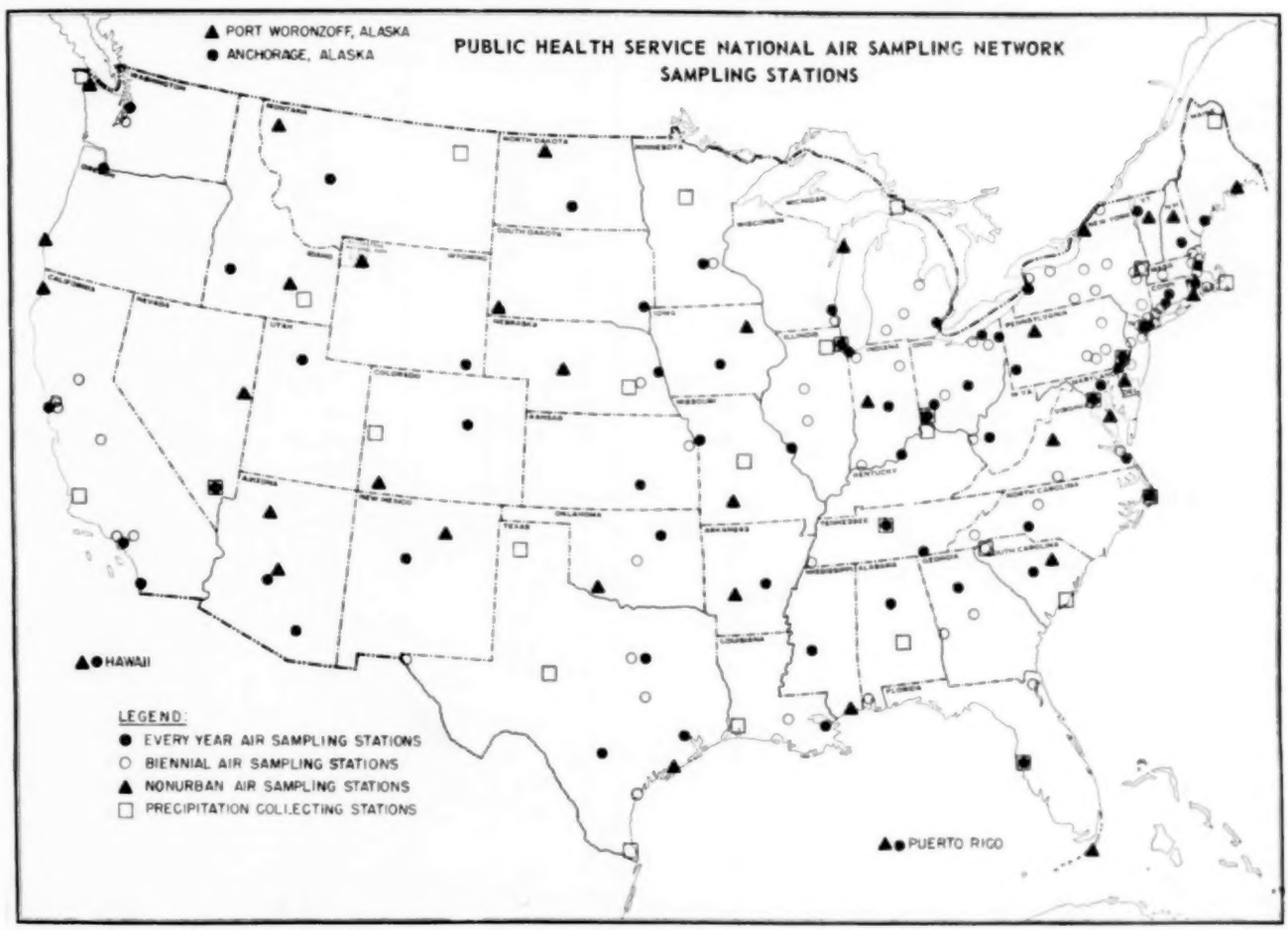


FIGURE 1

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR

National Air Sampling Network
Public Health Service

Third Quarter 1960

(μμc per cubic meter)

Station location	Number of samples	Minimum	Maximum	Average
Hartford, Conn.	7	(**)	0.2	0.1
New Haven, Conn.	7	0.1	0.1	0.1
Stamford, Conn.	7		0.2	0.1
Bridgeport, Conn.	7		0.1	0.1
Portland, Maine	6		0.2	0.1
*Acadia Nat. Pk., Maine	7	0.1	0.2	0.1
Boston, Mass.	7		0.2	0.1
Lawrence, Mass.	7		0.2	0.1
Lynn, Mass.	7		0.1	0.1
Somerville, Mass.	6		0.2	0.1
Fall River, Mass.	7		0.3	0.1
Quincy, Mass.	6	0.1	0.3	0.2
Springfield, Mass.	6	0.1	0.3	0.2
Manchester, N. H.	3	0.1	0.3	0.2
*Coos County, N. H.	6		0.2	0.1
Providence, R. I.	7		0.2	0.1
*Washington Co., R. I.	7		0.2	0.1
Burlington, Vt.	6		0.2	0.1
*Orange County, Vt.	7	0.1	0.3	0.1
Wilmington, Del.	6		0.2	0.1
*Kent County, Del.	6		0.2	0.1
Elizabeth, N. J.	7		0.2	0.1
Camden, N. J.	6		0.2	0.1
Trenton, N. J.	5		0.2	0.1
East Orange, N. J.	5		0.1	0.1
Newark, N. J.	7	0.1	0.1	0.1
New York, N. Y.	7	0.1	0.3	0.1
Binghamton, N. Y.	7	0.1	0.1	0.1
Schenectady, N. Y.	6	0.1	0.2	0.1
Syracuse, N. Y.	6		0.2	0.1
Utica, N. Y.	6		0.1	0.1
Albany, N. Y.	7	0.1	0.2	0.1
Rochester, N. Y.	7	0.1	0.2	0.1
Niagara Falls, N. Y.	5	0.1	0.5	0.2
New Rochelle, N. Y.	6	0.1	0.2	0.1
Troy, N. Y.	5		0.1	0.1
Massena, N. Y.	7	0.1	0.2	0.1
Glen Cove, N. Y.	5		0.1	0.1
Elmira, N. Y.	6	0.1	0.1	0.1
Mt. Vernon, N. Y.	7	0.1	0.2	0.1
*Cape Vincent, N. Y.	7		0.1	0.1
East Chicago, Ind.	5	0.1	0.1	0.1
Evansville, Ind.	7	0.1	0.8	0.2
Fort Wayne, Ind.	7	0.1	0.3	0.1
Indianapolis, Ind.	7	0.1	0.3	0.2
Gary, Ind.	7	0.1	0.2	0.1
*Montgomery Co., Ind.	7	0.1	0.2	0.1
Detroit, Mich.	7	0.1	0.3	0.1
Kalamazoo, Mich.	7	0.1	0.3	0.2
Lansing, Mich.	7	0.1	0.2	0.1
Saginaw, Mich.	7	0.1	0.3	0.2

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR--Con.

National Air Sampling Network
Public Health Service

Third Quarter 1960

(μμc per cubic meter)

Station location	Number of samples	Minimum	Maximum	Average
Cincinnati, Ohio	7	0.1	0.3	0.2
Youngstown, Ohio	7	0.1	0.1	0.1
Cleveland, Ohio	7	0.1	0.3	0.2
Columbus, Ohio	7	0.1	0.1	0.1
Lorain, Ohio	6	0.1	0.2	0.1
Akron, Ohio	7	0.1	0.2	0.2
Dayton, Ohio	7	0.1	0.2	0.1
Springfield, Ohio	7	0.1	0.3	0.2
Milwaukee, Wis.	6		0.1	0.1
Racine, Wis.	6	0.1	0.3	0.2
*Door County, Wis.	7		0.1	0.1
Des Moines, Iowa	7	0.1	0.3	0.2
*Clayton County, Iowa	7	0.1	0.2	0.1
Kansas City, Kans.	7	0.1	0.2	0.2
Wichita Kans.	6	0.1	0.2	0.1
Minneapolis, Minn.	6	0.1	0.1	0.1
St. Paul, Minn.	7	0.1	0.2	0.1
Kansas City, Mo.	7	0.1	0.3	0.2
St. Louis, Mo.	7		0.3	0.1
*Shannon County, Mo.	1	0.2	0.2	0.2
Omaha, Nebr.	7		0.2	0.1
Lincoln, Nebr.	7	0.1	0.3	0.2
Thomas County, Nebr.	6	0.1	0.2	0.2
Bismarch, N. Dak.	7		0.2	0.1
*Ward County, N. Dak.	6		0.2	0.1
Sioux Falls, S. Dak.	6		0.2	0.1
*Black Hills Forest, S. Dak.	5	0.1	0.2	0.1
Little Rock, Ark.	7		0.2	0.1
*Montgomery County, Ark.	7		0.2	0.1
New Orleans, La.	7		0.2	0.1
Baton Rouge, La.	7		0.1	0.1
Albuquerque, N. Mex.	7	0.1	0.5	0.2
Philadelphia, Pa.	7	0.1	0.2	0.1
Pittsburgh, Pa.	6	0.1	0.2	0.2
Lancaster, Pa.	4	0.1	0.3	0.2
Harrisburg, Pa.	7	0.1	0.2	0.1
Reading, Pa.	6	0.1	0.2	0.1
Wilkes Barre, Pa.	6	0.1	0.2	0.1
*Clarion County, Pa.	7	0.1	0.2	0.1
Washington, D. C.	5	0.1	0.2	0.1
Louisville, Ky.	4		0.2	0.1
Baltimore, Md.	6		0.2	0.1
*Calvert County, Md.	5		0.1	0.1
Charlotte, N. C.	6	0.1	0.2	0.1
Winston Salem, N. C.	7	0.1	0.2	0.1
Asheville, N. C.	7	0.1	0.2	0.1
*Cape Hatteras, N. C.	6		0.1	0.1
San Juan, P. R.	6		0.1	0.1
*Loquillo Mountains, P. R.	6		0.1	0.1
Norfolk, Va.	7		0.1	0.1
Hampton, Va.	6	0.1	0.2	0.2

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR--Con.

National Air Sampling Network
Public Health Service

Third Quarter 1960

(μμc per cubic meter)

Station location	Number of samples	Minimum	Maximum	Average
Danville, Va.	6	0.1	0.2	0.1
*Shenandoah National Park, Va.	6		0.3	0.1
Charleston, W. Va.	6	0.1	0.2	0.1
Huntington, W. Va.	7	0.1	0.3	0.1
Birmingham, Ala.	7		0.2	0.1
Mobile, Ala.	7		0.2	0.1
Tampa, Fla.	7		0.1	0.1
Jacksonville, Fla.	7		0.1	0.1
*Florida Keys, Fla.	4		0.1	
Atlanta, Ga.	5	0.1	0.1	0.1
Columbus, Ga.	6	0.1	0.2	0.1
Macon, Ga.	7		0.4	0.2
Jackson, Miss.	6		0.1	0.1
*Jackson County, Miss.	4		0.1	0.1
Columbia, S. C.	4	0.1	0.2	0.2
Greenville, S. C.	6		0.2	0.1
*Richland County, S. C.	6	0.1	0.3	0.2
Chattanooga, Tenn.	7	0.1	0.2	0.1
Nashville, Tenn.	7		0.2	0.1
Memphis, Tenn.	7		0.3	0.1
Chicago, Ill.	5	0.1	0.2	0.2
Springfield, Ill.	5		0.3	0.1
Peoria, Ill.	7	0.1	0.3	0.2
*Colfax County, N. Mex.	4		0.3	0.1
Tulsa, Okla	4	0.1	0.2	0.1
Oklahoma City, Okla.	7		0.2	0.1
*Cherokee Co., Okla.	7		0.2	0.1
Ft. Worth, Tex.	7		0.1	0.1
Houston, Tex.	7		0.1	0.1
Dallas, Tex.	5	0.1	0.1	0.1
San Antonio, Tex.	6		0.2	0.1
El Paso, Tex.	7		0.2	0.1
Corpus Christie	7		0.1	
Waco, Tex.	6		0.2	0.1
*Calhoun County, Tex.	3	0.1	0.1	0.1
Denver, Colo.	6	0.1	0.2	0.1
*Montezuma County, Colo.	6		0.1	0.1
Boise, Idaho	7	0.1	0.3	0.1
*Butte County, Idaho	4	0.1	0.2	0.2
Helena, Mont.	7	0.1	0.3	0.2
*Glacier National Park, Mont.	8	0.1	0.4	0.2
Salt Lake City, Utah	6	0.1	0.3	0.2
Cheyenne, Wyo.	4		0.1	0.1
*Yellowstone Park, Wyo	7		0.2	0.1
Anchorage, Alaska	7			
*Pt. Woronzof, Alaska	7		0.1	
Phoenix, Ariz.	6	0.1	0.3	0.1
Tucson, Ariz.	6	0.1	0.2	0.1
*Maricopa Co., Ariz.	6	0.1	0.2	0.1
*Grand Canyon Park, Ariz.	3	0.1	0.3	0.2
Los Angeles, Calif.	6	0.1	0.1	0.1
San Francisco, Calif.	7		0.1	0.1
Pasadena, Calif.	7	0.1	0.2	0.1

TABLE 1.--GROSS BETA RADIOACTIVITY IN AIR--Con.

National Air Sampling Network
Public Health Service

Third Quarter 1960

(μμc per cubic meter)

Station location	Number of samples	Minimum	Maximum	Average
San Diego, Calif.	7	0.1	0.1	0.1
Burbank, Calif.	7		0.2	0.1
Fresno, Calif.	7	0.1	0.2	0.2
Oakland, Calif.	7		0.1	0.1
Sacramento, Calif.	7		0.1	0.1
Richmond, Calif.	7		0.1	0.1
*Humboldt County, Calif.	4			
Honolulu, Hawaii	7		0.1	0.1
*Barbers Point, Ewa County, Hawaii	7		0.1	0.1
Las Vegas, Nev.	7		0.4	0.2
*White Pine County, Nev.	5	0.1	0.2	0.1
Portland, Oreg.	6		0.1	0.1
*Curry County, Oreg.	5		0.1	0.1
Tacoma, Wash.	7	0.1	0.2	0.1
*Clallam County, Wash.	1	0.1	0.1	0.1

*Nonurban station.

**A blank space in the table indicates that the level was below the minimum detectable value of 0.1 μμc/m^3.

GROSS BETA RADIOACTIVITY IN PRECIPITATION

National Air Sampling Network
Precipitation Collection Section
Public Health Service

During 1959 a precipitation collection and analysis program was established by the Weather Bureau Research Station in Cincinnati, Ohio, and the National Air Sampling Network. The collection stations are located at Weather Bureau Offices or Airport Stations. Monthly composite samples of precipitation are collected at 29 stations and forwarded to the Network laboratory for analysis. A list of these precipitation collection stations is given below. Samples are analyzed for total solids and a large number of metals and nonmetals. In addition, samples representing 85% or more of the official rainfall recorded at the collecting stations are analyzed for gross beta radioactivity if a large enough volume remains after the needs for the chemical analysis have been met.

Quarterly data on gross beta radioactivity of precipitation will be published in the Radiological Health Data Quarterly Reports. Table 1 presents the data for the third quarter 1960.

TABLE 1.--GROSS BETA RADIOACTIVITY OF PRECIPITATION

National Air Sampling Network
Public Health Service

Third Quarter 1960

Station location	July		August		September	
	μμc/liter	μμc/m²	μμc/liter	μμc/m²	μμc/liter	μμc/m²
Albany, New York	23	3,100	-	-	4	800
Brownsville, Texas	-	-	-	-	3	300
Cape Hatteras, North Carolina	14	2,100	15	1,400	13	1,000
Charleston, West Virginia	5	1,600	10	700	5	900
Chicago, Illinois (Midway Airport)	25	2,000	-	-	-	-
Chicago, Illinois (O'Hare Airport)	21	2,200	-	-	-	-
Cincinnati, Ohio (Airport)	16	2,000	-	-	-	-
Cincinnati, Ohio (WBRS)	17	1,400	13	2,000	-	-
Columbia, Missouri	40	3,200	-	-	-	-
Grand Island, Nebraska	36	2,700	13	700	15	800
Greenville, South Carolina	16	1,900	15	1,800	14	1,500
Lake Charles, Louisiana	-	-	6	900	1	100
Montgomery, Alabama	-	-	-	-	9	1,300
Nantucket, Maine	-	-	-	-	5	300
Nashville, Tennessee	-	-	-	-	4	400
Philadelphia, Pennsylvania	34	4,400	-	-	-	-
St. Cloud, Minnesota	-	-	9	1,000	-	-
Sault Ste. Marie, Michigan	15	1,100	-	-	-	-
Tampa, Florida	6	2,800	-	-	-	-
Washington, D. C.	8	800	16	2,300	-	-

- No data available due to low collection efficiency or inadequate sample.

NAVAL RESEARCH LABORATORY RADIOACTIVITY MEASUREMENTS

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during August 1960 is shown in Table 1, while the radioactivity profile for the same month is shown in Figure 1. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site. (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter.)

TABLE 1.--DAILY RECORD OF FISSION PRODUCT B-ACTIVITY COLLECTED BY AIR FILTRATION

U. S. Naval Research Laboratory

August 1960

(Disintegrations/minute per cubic meter)

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador
1	0.02	0.01	-	0.08	0.07	0.04	0.11
2	-	0.02	0.13	-	0.04	Tr	0.09
3	-	0.02	0.13	-	0.04	Tr	0.04
4	-	0.01	0.11	0.23	0.05	0.02	0.04
5	-	0.01	0.11	0.23	0.05	0.02	0.05
6	0.01	0.03	0.08	0.12	0.02	0.03	0.05
7	0.01	0.03	0.08	0.12	0.02	0.03	0.05
8	0.01	0.03	0.08	0.12	0.02	0.03	0.05
9	Tr	0.03	0.09	0.08	0.06	0.04	0.05
10	Tr	0.03	0.09	0.08	0.06	0.04	0.04
11	0.07	0.07	0.07	0.07	0.08	0.09	0.04
12	0.07	0.07	0.07	0.07	0.08	0.09	0.04
13	0.02	0.03	0.08	0.06	0.03	0.01	0.05
14	0.02	0.03	0.08	0.06	0.03	0.01	0.02
15	0.02	0.03	0.08	0.06	0.03	0.01	0.02
16	0.03	0.02	0.07	0.09	0.06	0.05	0.05
17	0.03	0.02	0.07	0.09	0.06	0.05	0.07
18	-	0.01	0.05	0.10	0.06	0.01	0.02
19	-	0.01	0.05	0.10	0.06	0.01	0.07
20	-	0.05	0.07	0.09	0.07	Tr	0.04
21	-	0.05	0.07	0.09	0.07	Tr	0.04
22	-	0.05	0.07	0.09	0.07	Tr	0.04
23	-	0.04	-	0.08	0.07	0.04	0.05
24	-	0.04	-	0.08	0.07	0.04	0.05
25	-	0.04	0.17	0.12	0.04	0.07	0.07
26	-	0.04	0.17	0.12	0.04	0.07	0.07
27	-	-	0.10	0.05	0.09	0.02	0.04
28	-	-	0.10	0.05	0.09	0.02	0.04
29	-	-	0.10	0.05	0.09	0.02	0.06
30	-	-	0.07	0.05	0.09	0.06	0.06
31	-	-	0.07	0.05	0.09	0.06	0.09
Mean value	0.02	0.03	0.09	0.09	0.06	0.03	0.05

Tr--Trace.

TABLE 1.--DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION--Con.

U. S. Naval Research Laboratory

August 1960

(Disintegrations/minute per cubic meter)

Day	Miraflores, Panama Canal	Mauna Loa, Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland	Bravo, Artic Ice Floe
1	0.03	0.09	0.08	0.37	0.26	0.54	0.02
2	0.05	0.08	0.13	0.40	0.12	0.28	0.04
3	0.05	0.08	0.13	0.40	0.12	0.28	0.04
4	0.02	0.11	0.10	0.23	0.08	0.04	0.04
5	0.02	0.11	0.10	0.23	0.08	0.04	0.04
6	0.05	0.07	0.09	0.14	0.11	0.04	0.04
7	0.05	0.07	0.09	0.14	0.11	0.04	0.04
8	0.05	0.07	0.09	0.14	0.11	0.04	0.04
9	0.05	0.15	0.09	0.25	0.09	0.26	0.03
10	0.05	0.15	0.09	0.25	0.09	0.26	0.03
11	0.02	0.11	0.15	0.20	0.17	0.15	0.03
12	0.02	0.11	0.15	0.20	0.17	0.15	0.03
13	0.02	0.06	0.17	0.17	0.13	0.12	0.03
14	0.02	0.06	0.17	0.17	0.13	0.12	0.03
15	0.02	0.06	0.17	0.17	0.13	0.12	0.03
16	0.05	0.07	0.20	0.24	0.10	0.22	0.01
17	0.05	0.07	0.20	0.24	0.10	0.22	0.01
18	0.05	0.23	0.21	0.29	-	0.05	0.01
19	0.05	0.23	0.21	0.29	-	0.05	0.01
20	0.06	0.23	0.21	0.30	0.25	0.07	0.01
21	0.06	0.23	0.21	0.30	0.25	0.07	0.01
22	0.06	0.23	0.21	0.30	0.25	0.07	0.01
23	0.04	0.13	0.12	0.27	0.10	0.13	0.04
24	0.04	0.13	0.12	0.27	0.10	0.13	0.04
25	0.05	0.10	0.06	0.27	0.28	0.18	0.04
26	0.05	0.10	0.06	0.27	0.28	0.18	0.04
27	0.01	0.10	0.15	0.25	0.19	0.20	0.04
28	0.01	0.10	0.15	0.25	0.19	0.20	0.04
29	0.01	0.10	0.15	0.25	0.19	0.20	0.04
30	0.01	-	0.08	0.16	0.20	0.12	0.02
31	0.01	-	0.08	0.16	0.20	0.12	0.02
Mean value	0.05	0.12	0.14	0.24	0.16	9.15	0.03

Tr--Trace.

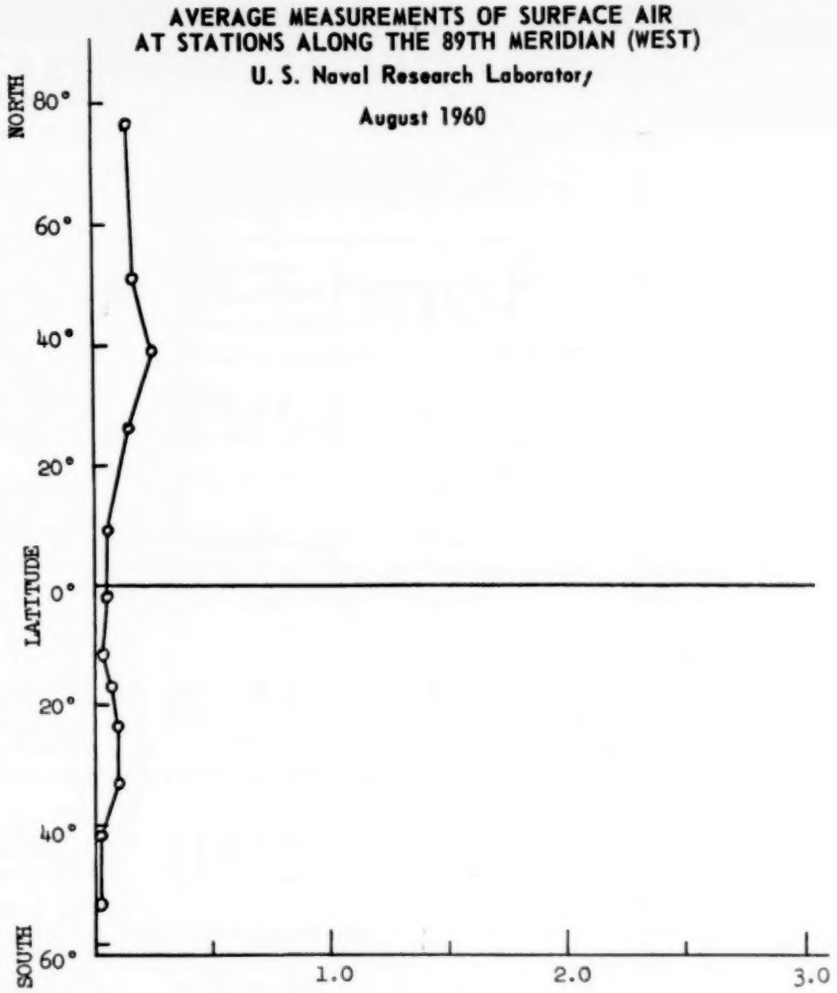


FIGURE 1

CANADIAN RADIOACTIVE FALLOUT STUDY PROGRAM

Department of National Health and Welfare
Dominion of Canada

As part of its radioactive fallout study program, the Radiation Protection Division, Department of National Health and Welfare, Dominion of Canada conducts air and precipitation sampling programs.

The operation of the nation-wide air sampling program is conducted for two main purposes: (1) To provide a convenient method for the early detection of changes in the fission product concentration in the air and therefore of likely changes in the deposition of fission products on the ground, and (2) To obtain data to show the day to day and station to station variations. This may be useful to meteorologists in a better understanding of the mechanisms involved in radioactive fallout distribution in the atmosphere.

A more detailed discussion of the sampling procedures, methods of analysis, and interpretation of results of the Department's radioactive fallout program is contained in the "Annual Report for 1959," Report Number CNHW (RP-3).

Tables 1 and 2 give the data on total beta activity in air for the period of July 1959- June 1960. Tables 3 and 4 give the data on total beta activity in precipitation for January-December 1959 and January-June 1960.

These data are reproduced in the present form through the permission of the Department of National Health and Welfare, Dominion of Canada.

TABLE 1.--TOTAL BETA RADIOACTIVITY IN AIR

Canadian Radioactive Fallout Study Program

July 1959-June 1960

Station location	Monthly average in dpm/m^3											
	July	August	September	October	November	December	January	February	March	April	May	June
Aklavik	0.90	0.50	0.54	0.25	0.37	0.27	0.28	0.37	0.42	0.50	0.37	0.27
Calgary	-	-	0.11	0.32	0.37	0.32	0.32	0.36	0.54	0.60	0.51	0.49
Chatham	-	-	-	-	-	-	-	0.23	0.38	0.37	0.33	0.43
Coral Harbour	-	0.76	0.35	0.26	0.27	0.37	0.25	0.33	0.39	0.53	0.33	0.35
Edmonton	1.79	0.92	0.51	0.34	0.30	0.32	0.28	0.36	0.48	0.55	0.40	0.38
Fort Churchill	-	-	-	-	-	0.27	0.26	0.48	0.42	0.68	0.35	0.32
Fort William	-	-	-	-	0.34	0.27	0.27	0.45	0.56	0.40	0.49	0.45
Fredericton	-	-	-	-	-	-	-	-	-	0.26	0.32	0.36
Kapuskasing	-	0.65	0.40	0.31	0.34	-	-	0.46	0.49	0.50	0.61	0.52
Montreal	-	-	0.62	0.30	0.30	-	-	0.25	0.37	0.40	0.41	0.57
Moosonee	-	0.58	0.46	0.30	0.26	0.28	0.25	0.42	0.44	0.44	0.42	0.42
Ottawa	2.33	1.52	1.17	0.29	0.34	0.28	0.23	0.25	0.69	0.37	0.54	0.56
Regina	-	1.13	0.55	0.30	0.29	0.26	0.33	0.41	0.44	0.45	0.53	0.46
Resolute	0.75	0.53	0.31	0.22	0.33	0.28	0.22	0.47	0.39	0.50	0.31	0.18
Saskatoon	-	-	-	-	0.25	0.29	0.31	0.43	0.46	0.54	0.54	0.50
Shearwater	-	-	-	-	-	-	-	-	-	0.36	0.35	0.31
Torbay	-	-	-	-	0.31	0.21	0.20	0.20	0.28	0.28	0.24	0.33
Toronto	-	-	0.82	0.40	0.32	-	-	0.31	0.45	0.48	0.44	0.58
Vancouver	-	-	-	0.27	0.27	0.20	0.18	0.35	0.47	0.33	0.23	0.26
Whitehorse	-	-	0.28	0.32	0.22	0.16	0.26	0.50	0.38	0.34	0.38	0.18
Windsor	-	-	0.54	0.35	0.35	0.29	0.31	0.37	0.52	0.57	0.50	0.64
Winnipeg	-	-	0.46	0.33	0.35	0.26	0.34	0.51	0.54	0.40	0.53	0.45
Yellowknife	-	1.04	0.50	0.28	0.33	0.29	0.36	0.49	0.42	0.51	0.46	0.47

TABLE 2.--MONTHLY AVERAGE FISSION PRODUCT CONCENTRATION IN AIR

Canadian Radioactive Fallout Study Program

July 1959-June 1960

(Radioactivity in dpm/m^3)

Month	Number of stations operating 50 percent of the time	Minimum average all stations	Maximum station average	Overall average
July 1959	0*	-	-	1.44
August 1959	7	0.50	1.52	0.85
September 1959	13	0.28	1.17	0.51
October 1959	16	0.22	0.40	0.30
November 1959	17	0.22	0.37	0.31
December 1959	17	0.16	0.37	0.27
January 1960	17	0.18	0.36	0.27
February 1960	21	0.20	0.51	0.38
March 1960	21	0.28	0.69	0.45
April 1960	22	0.28	0.68	0.46
May 1960	22	0.23	0.61	0.42
June 1960	23	0.18	0.64	0.41

*Four stations were operating for a short time during July.

TABLE 3.–TOTAL BETA RADIOACTIVITY IN PRECIPITATION

Canadian Radioactive Fallout Study Program

January-December 1959

Station location	January		February		March		April		May		June	
	μμc/l	inches	μμc/l	inches	μμc/l	inches	μμc/l	inches	μμc/l	inches	μμc/l	inches
Aklavik												
Calgary												
Coral Harbor												
Dartmouth	221	4.3	251	3.01	194	5.77	257	8.92	188	2.21	188	7.81
Deep River							248	2.67	248	2.12	771	0.96
Edmonton	210	0.91	386	0.25	410	0.25	1,088	0.28	375	1.74	26	3.06
Fort Churchill	123	0.63	375	0.54	1,306	0.40	1,267	0.39	1,736	1.08	1,253	1.05
Fort William												
Kapuskasing												
La Durantye	68	4.27	204	2.38	128	3.98						
London	73	4.97	220	2.47	422	2.49	373	2.84	128	4.59	257	0.87
Montreal												
Moosonee												
Ottawa	27	3.12	245	3.14	450	2.28	1,050	1.25	772	0.95		
Regina												
Resolute												
Sable Island	120	5.44	25	6.98								
Saskatoon												
Sulphur Mountain			20	5.2					362	2.52	171	5.75
Torbay	127	5.00			22	5.12			296	2.22		
Toronto												
Vancouver												
Whitehorse												
Windsor												
Winnipeg	625	0.22	192	0.98	198	1.02						
Yellowknife												
Average	177		213		391		714		513		444	

Station location	July		August		September		October		November		December	
	μμc/l	inches	μμc/l	inches	μμc/l	inches	μμc/l	inches	μμc/l	inches	μμc/l	inches
Aklavik					68	2.52	29	1.5	69	0.73	47	0.64
Calgary					233	0.24	173	0.28	74	0.7	197	0.99
Coral Harbor			193	1.72			65	1.53	245	0.41	119	0.39
Dartmouth												
Deep River	871	1.92										
Edmonton			135	3.86			153	1.62	73	0.45	64	1.02
Fort Churchill											38	2.02
Fort William									30	1.77	37	1.40
Kapuskasing					49	3.11	21	5.46	32	2.74	17	1.09
La Durantye												
London												
Montreal					78	1.50	24	5.69	39	3.61	97	1.4
Moosonee			164	2.68	63	2.44	73	2.23	66	1.88	65	0.51
Ottawa			39	4.19	48	3.86	31	3.26	24	3.30	56	4.10
Regina					36	5.09	64	1.64	46	1.14	45	0.89
Resolute			74	0.89	91	1.4						
Sable Island												
Saskatoon											17	0.89
Sulphur Mountain												
Torbay	270	1.56	58	3.87	34	5.77	31	6.52	13	10.94		
Toronto					39	4.05	5	3.42				
Vancouver									20	6.18	32	5.60
Whitehorse					135	0.85	59	0.50	195	0.41	70	0.50
Windsor					31	3.34	20	5.00	30	3.08	17	3.12
Winnipeg					21	2.45	37	3.44	163	0.71	253	0.38
Yellowknife					47	1.83	48	2.66	40	1.48	19	0.89
Average	570		110		70		56		72		70	

Note: Blank space indicates no sample.

TABLE 4.--TOTAL BETA RADIOACTIVITY IN PRECIPITATION

Canadian Radioactive Fallout Study Program

January-June 1960

Station location	January		February		March		April		May		June	
	μμc/liter	inches	μμc/liter	inches	μμc/liter	inches	μμc/liter	inches	μμc/liter	inches	μμc/liter	inches
Aklavik	3.65	0.71			453.7	0.14	174	0.3	444.6	0.16	580	0.06
Calgary	298	.21	35	1.23			116	1.59	113	1.68	100	4.02
Chatham N.B.	0.15	6.88	20.4	6.88	10.6	9.72						
Coral Harbour	266	.22	81.6	.73	126.3	.26	23.9	2.02	118	.95	52.6	1.44,
Edmonton	152	.26	53.7	.86	137.6	.38			88.1	2.72	65.8	2.86
Fredericton									37.5	5.25	64.5	2.95
Fort Churchill	55.3	1.30	7.1	2.90	50.6	.81	33.7	2.69	50.3	2.01		
Fort William	8.2	1.26	15.1	3.20	107.9	.59	57.8	2.45	44.4	3.32	78.9	2.44
Kapuskasing	35	1.70	7.4	3.00	96.5	1.17	166	1.17	75.6	2.57	52.8	1.99
Montreal	36.5	2.48	28.6	6.90	55	3.15	78.6	2.66	104	2.00	74.8	2.45
Moosonee	38.9	1.61	18.7	3.23	88.9	1.12						
Ottawa	65.7	1.53	23.6	5.10	56.8	1.95	64	2.58	82.3	3.18	52.1	3.03
Regina	60.3	.73	719	.45	482	.30	162	.86	71.3	2.30	65.4	5.19
Resolute							37.1	.60	53.1	3.60	68.3	0.26
Saskatoon	105	.44	23.3	.66	105.5	.69	160	.59	94.5	2.09	76.2	2.60
Shearwater N.S.							555	.11			52.6	3.44
Torbay	23.9	7.28	25.2	7.14	19	7.23	41.7	1.14	18	3.77	50.7	2.72
Toronto			32.4	3.27	27.2	1.85	94.2	2.63	79.9	4.08	97.2	2.33
Vancouver	17	6.47	23	4.92	31.5	4.24	54.9	1.77	57.4	3.43	140	.60
Whitehorse	87.3	.74			26	.79			56	.37	79.1	1.20
Windsor	25.8	3.19	56.1	2.07	27.7	2.04	46.7	1.67	68.5	2.54	36.3	6.38
Winnipeg	44.5	.69	223.6	.45	73	1.21	103	1.06	95.8	1.34	94.5	2.18
Yellowknife	76.8	.40	7.6	.80	31	.83	98.3	.13	105	.98	103	.54
Average	73.7		77.8		105.6		114.8		92.9		99.2	

SECTION II.—FOOD, OTHER THAN MILK

SURVEY OF RADIOACTIVITY IN FOOD

Food and Drug Administration

As an index of fallout contamination, the Food and Drug Administration, U. S. Department of Health, Education, and Welfare has conducted surveys of total beta radioactivity in a variety of foods since 1957. Correction for potassium-40 has been made in the total beta radioactivity. The total potassium content was determined by flame photometry and the K^{40} contribution calculated using a known ratio of K^{40} to total potassium. This type of survey lends itself to the rapid analyses of many more samples than would be possible if individual nuclides such as strontium-90 were determined. Care has been taken to ensure that all samples from a given period were approximately the same age when analyzed. This permits meaningful interpretation of differences between varieties and growing areas.

From June 1959 to June 1960, 23 samples of food were examined for total beta and strontium-90 and the results expressed as percent strontium-90 of total beta. The period of time during which this relationship was studied varied from 8 to 20 months following cessation of nuclear weapons testing. The total beta concentration therefore did not reflect the presence of shorter lived beta emitting nuclides. The relationship of strontium-90 to total beta in these 23 samples was found to average 9.5%. This compares to the average strontium-90 content of 9.8% in 17 samples of alfalfa, 9.6% in a second set of 24 samples of alfalfa, and 6.4% in 27 samples of corn ensilage collected during the same time period.

Tables 1 and 2 show the results of analyses of about 1000 samples of vegetables and 700 samples of fruits respectively. The survey represents fresh and processed samples. Vegetables carry a greater burden of radioactivity than fruits, and this is most notable in spinach, celery, lettuce, and greens. Lower values in 1959 are a reflection of the decay of the short lived components of fallout. Regional distribution of fallout contamination as reflected in this type of survey is shown in table 3.

Table 4 shows the results of a limited survey on sea food. Oysters and clams carry the largest burden of contamination. Attention is also called to the fact that the total beta radioactivity in these two sea foods has not materially decayed in 1959.

Table 5 shows in summary the analyses of a large number of tea samples originating from different parts of the world. Highest radioactivity is confined to Japanese, Formosan and Indian teas. It is noteworthy that the beta radioactivity has not shown any marked decline in the three sampling periods. The high total beta radioactivity reflects strontium-90 concentrations ranging as high as 1300 uuc/kg for tea from India as reported in Radiological Health Data, May 1960.

TABLE 1.—TOTAL BETA RADIOACTIVITY IN VEGETABLES

Vegetable	Year	No. samples	Total beta dpm/gm
Spinach.....	1958	71	11.0
	1959	85	4.1
Celery	1958	67	7.4
	1959	70	3.2
Lettuce.....	1958	101	6.7
	1959	95	1.4
Greens*.....	1958	11	5.8
	1959	28	3.1
Green beans	1958	40	1.2
	1959	55	0.2
Beans (shelled).....	1958 & 1959	24	1.9
Corn	1958	9	0.3
	1959	10	0.2
Brassica**	1958	134	1.1
	1959	213	0.4
Asparagus.....	1958 & 1959	12	0.5
Potatoes.....	1958 & 1959	31	0.0
Peas.....	1958 & 1959	11	0.0
Average.....			3.0

* Greens include kale, turnip greens, collards, mustard greens and dandelion.

** Brassica include broccoli, cabbage, cauliflower and brussel sprouts.

TABLE 2.—TOTAL BETA RADIOACTIVITY IN FRUITS

Fruits	Year	No. samples	Total beta dpm/gm
Plums & prunes	1958 & 1959	25	2.8
Strawberries.....	1958 & 1959	51	1.7
Dates & figs.....	1958	148	1.0
Berries*.....	1958 & 1959	42	0.8
Apples & pears.....	1958	94	0.4
	1959	102	0.0
Cherries.....	1958 & 1959	40	0.4
Grapes.....	1958 & 1959	35	0.4
Peaches & Apricots..	1958 & 1959	50	0.4
		70	0.1
Tomatoes & peppers	1958 & 1959	34	0.3
		34	0.0
Average.....			0.4

* Berries include: blueberries, blackberries, gooseberries, raspberries, and dewberries.

TABLE 3.—TOTAL BETA RADIOACTIVITY IN FRUITS AND VEGETABLES BY AREAS

Area	Year	Fruits*		Vegetables**	
		No. samples	Total beta dpm/gm	No. samples	Total beta dpm/gm
Northeast (a)	1958	38	0.6	89	1.9
	1959	48	0.2	185	0.8
North Central (b)	1958	65	0.7	116	4.7
	1959	101	0.9	177	1.7
South (c)	1958	45	0.6	54	3.3
	1959	70	0.6	142	1.4
West (d)	1958	97	0.6	237	7.4
	1959	92	0.0	192	2.4

(a) Northeast Area consists of: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.

(b) North Central Area consists of: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

(c) South Area consists of: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas.

(d) West Area consists of: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, and California.

*Fruits include: grapes, peaches, berries, apples, cherries, tomatoes, plums, apricots, nectarines, etc.

**Vegetables include: corn, spinach, green beans, cabbage, broccoli, potatoes, peas, kale, brussel sprouts, celery, cauliflower, asparagus, peppers, lettuce, beans, parsley, collards, mustard greens, turnip greens, onions, water cress, etc.

TABLE 4.—TOTAL BETA RADIOACTIVITY IN SEA FOOD

Food item	Year	No. samples	Total beta dpm/gm
Oysters	1958	6	2.8
	1959	12	2.7
Clams	1958	14	1.4
	1959	24	1.5
Shrimp (canned)	1958-1959	13	0.0
Salmon	1958	50	0.5
	1959	27	0.3
Tuna fish (canned)	1958-1959	38	0.0

TABLE 5.—TOTAL BETA RADIOACTIVITY IN TEA

Areas of the world	Period when sampled	No. samples	Total beta dpm/gm
Africa[a]....	Aug.—Dec. 1958	20	8.5
	Jan.—June 1959	13	8.3
	July 1959—Jan. 1960	38	5.3
Brazil.....	Aug.—Dec. 1958	37	11.7
	Jan.—June 1959	12	4.3
	July 1959—Jan. 1960	14	4.3
East Indies [b]	Aug.—Dec. 1958	89	10.7
	Jan.—June 1959	18	4.5
	July 1959—Jan. 1960	80	4.4
India[c].....	Aug.—Dec. 1958	89	23.6
	Jan.—June 1959	72	9.8
	July 1959—Jan. 1960	312	19.9
Japan [d]....	Aug.—Dec. 1958	170	48.8
	Jan.—June 1959	79	31.7
	July 1959—Jan. 1960	77	43.4

(a) Includes: Kenya, Belgian Congo, Tanganyika, Mozambique, Nyasaland, Portuguese E. Africa, and Uganda.
(b) Includes: Java, Sumatra, Indonesia, and Malaya.
(c) Includes: India, Ceylon, and Pakistan.
(d) Includes: Japan and Formosa.

STRONTIUM-90 CONCENTRATION IN FOOD SAMPLES TAKEN IN STATE OF ALASKA

The Lamont Geological Observatory of Columbia University at Palisades, N. Y., has conducted strontium-90 analyses of food samples from Alaska, collected in cooperation with the Public Health Service Arctic Health Research Center and the University of Alaska.

Table 1 presents the strontium-90 concentration in the food samples.*

At the beginning of the project, it was considered that the strontium-90 body burden of the average Alaskan might not be particularly high due to:

a. rather low rainfall so that the strontinum-90 is not washed out in proportion to its atmospheric concentration.

b. the fact that the major portion of the diet for urban areas is imported.

c. the extensive use of fish and other aquatic life in the native diet.

However, because some Eskimos subsist almost entirely on caribou meat, one might expect high strontium-90 body burdens among those persons.

While the data in table 1 are limited, several features are evident:

a. Stable foods from the Fairbanks area have approximately the same strontium-90 analyses as foods from other U. S. locations.

b. Marine life is characterized by low values of strontium-90 as shown by the assay of whale, seal, walrus, as well as that of the polar bear, which also lives on marine life. (There is an anomaly here with respect to one walrus meat sample which shows 360 $\mu\mu c$ Sr^{90}/gm Ca.)

c. Fresh water fish have strontium-90 levels which are at least one order of magnitude greater than the marine life as indicated by both beluga and whitefish samples.

d. The only analysis of caribou meat shows a high value of strontium-90.

*Data reported by Dr. A. R. Schulert, Lamont Geological Observatory, supported under a contract with AEC.

TABLE 1.–STRONTIUM-90 CONCENTRATION IN ALASKAN FOOD SAMPLES

Food	Location	Collection date	Strontium-90 content		
			dpm/kg wet	dpm/gm ash	μμc Sr^{90}/gm Ca
Wheat	Fairbanks	1957	22.0	1.42	22.6
Wheat	Fairbanks	1958	98.0	6.38	104.7
Wheat	Fairbanks	1959	106	6.20	125.1
Cabbage	Fairbanks	1959	5.94	1.11	7.8
Potatoes	Fairbanks	1959	1.62	0.17	7.8
Whale meat	Pt. Hope	Oct. '59	≤0.04	≤0.07	≤2.4
Whale rib (bowhead)	St. Lawrence	May '59	≤64	≤0.12	≤0.13
Seal backbone	Pt. Hope	Fall '59	8.40	0.07	0.08
Tom Cod	Pt. Hope	Dec. '59	3.45	0.05	0.10
Polar bear meat	Pt. Hope	Fall '59	≤0.6	≤0.06	≤2.8
Walrus backbone	St. Lawrence	Spring '59	324	0.65	0.77
Walrus meat	St. Lawrence	Spring '59	180	9.38	360
Needlefish	Hooper Bay	Oct. '59	605	7.24	7.57
Dried flounder plus herring	Newfok	Oct. '59	110	1.46	2.70
cod	Kotzebue	Oct. '59	362	6.63	7.85
Whitefish	Kobuk River	Oct. '59	156	2.26	15.7
Whitefish	Kobuk River	Spring '60	(2,390)*	42.4	62.4
Whitefish	Kobuk River	Spring '60	(115)*	2.03	3.54
Whitefish	Kobuk River	Spring '60	(1,410)*	25.0	32.8
Beluga meat	Kotzebue	Oct. '59	0.39	0.12	8.8
Beluga meat	Kotzebue	Fall '59	26.3	0.81	142.3
Beluga meat	Kotzebue	Oct. '59		0.67	11.5
Caribou meat	Anaktuvuk Pass	Nov. '59	16.0		160
Caribou antlers	Anaktuvuk River	Oct. '59	9,450	238	281
Caribou antlers	Anaktuvuk River	Oct. '59	6,480	146	170
Caribou antlers	Tolugak Creek	Oct. '59	6,400	143	170
Plant roots	Shungnak	Oct. '59	106	4.30	16.7
Caribou stomach contents	Anaktuvuk River	Nov. '59	7,880	245	1,264

*These values approximate, since accurate wet weights were not obtained on these samples.

STRONTIUM-90 IN FOOD

Health and Safety Laboratory
U. S. Atomic Energy Commission

The Health and Safety Laboratory has analyzed samples of vegetables from the Brawley, California area for calcium and strontium-90 content. The following table gives the values for samples collected at about yearly intervals since 1957. The data first appeared in Health and Safety Laboratory Report, HASL-90, dated August 18, 1960.

TABLE 1.—STRONTIUM-90 IN FOODS FROM BRAWLEY, CALIF.

Sampling period	Type food	gm Ca/kg wet weight	μμc Sr^{90}/kg wet weight	μμc Sr^{90}/gm Ca
February 1957.....	Pea pods	0.52	<0.16	<0.3
	Broccoli	1.3	1.6	1.2
	Cantaloupe rinds and flesh	9.9*	<3.0	<0.3
	Cataloupe seeds	12.7*	<2.5	<0.2
January 1959	Lettuce.....	0.35	2.4	6.8
	Broccoli.....	1.0	2.4	2.4
	Cabbage.....	-	1.8	-
December 1959.....	Lettuce.....	0.28	1.9	6.8
	Broccoli.....	0.63	1.3	2.0
	Cabbage.....	0.44	2.2	5.1

*Dry weight.

STRONTIUM-90 CONTENT IN THE MILITARY DIET IN PERU AND ECUADOR (1959)[1]

Nutritional surveys on native military populations in South American countries conducted by the U. S. Interdepartmental Committee on Nutrition for National Defense have made available comprehensive information on diet and nutritional status of these groups of people. As a result of these surveys, composite diets have been made available to Lamont Geological Observatory of Columbia University to provide assessment of dietary ingestion of radionuclides as reflected in the strontium-90 content. Data presented herein are for the countries of Peru and Ecuador.

The average daily intake per person of strontium-90 for Peru is 2.81μμc. See table 1. This radionuclide concentration is roughly 18 percent of the value of 15.4μμc reported by Straub et al[2] in the diet of persons living in Cincinnati, Ohio.

Since fallout debris is washed out of the atmosphere by rain, correlations have been made between distribution of radionuclides in soil and foliar contamination on plants which is ultimately reflected in foodstuffs. In table 2, the relationship between rainfall and dietary concentration of strontium-90 (μμc per gram of calcium) is shown for various locations in Peru.

Since importation of foods from other countries may be involved in some instances, the relationship may be qualitative. The value for the city of Iquitos may be somewhat lower than expected despite the high rainfall, since the military at this base import large amounts of their food from other areas and consume only 20 percent of food grown locally.

The military establishments in Peru have a food supplement day, about every third day, at which time extra rations are provided principally in the form of fruit. The higher strontium-90 concentration in the diet on those days reflects this supplement which consists mainly of bananas and oranges. The Lamont analyses have shown that bananas have a particularly high strontium-90/calcium ratio.

In table 3, the strontium-90 content for the military diets in Ecuador for 1959 is shown for seven locations. The daily intake of strontium-90 is somewhat lower than that for Peru but the difference is not large. Of significance however is the fact that the contamination of foodstuffs with radioactivity in Ecuador is about 7 percent of that reported in the United States during 1959. Reference is made to table XII, "Estimate of Strontium-90 in United States Diets," Radiological Health Data, October 1960.

[1]Reported to the U. S. Atomic Energy Commission by Dr. A. R. Schulert, Lamont Geological Observatory, Columbia University in Annual Report dated October 1, 1960. This study was performed through cooperative arrangement between the ICNND and AEC.

[2]Straub, C. P., G. K. Murthy, and J. E. Campbell, "Radionuclides in Foods"--a paper presented at the Annual meeting of the Ohio Dietetic Association, Cincinnati, Ohio, May 6, 1960.

TABLE 1.--STRONTIUM-90 CONTENT OF MILITARY DIET IN PERU (1959)

Location	Date	Strontium-90	
		μμc/person/day	μμc/gm Ca
Chorillos	February 24	3.21	2.25
	25	2.80	1.71
	26	4.16	*3.52
	Average...	3.39	2.49
Piura	April 9	4.28	1.43
	10	2.74	*2.74
	11	2.55	1.08
	Average...	3.19	1.75
Taena....	March 10	2.80	2.03
Tumbes	April 13	3.25	1.61
	14	2.89	2.22
	15	1.77	*3.76
	Average...	2.63	2.53
Arequipa	March 9	1.79	2.11
	10	2.29	3.33
	Average...	2.04	2.72
Puno.....	March 16	2.55	3.51
Iquitos...	March 31	-	1.54
	April 1	-	1.75
	April 2	2.29	6.79
	Average...	2.29	3.36
Average daily intake..		2.81	2.63

*Supplement Day--extra food supplied, principally fruit.

TABLE 2.--RELATIONSHIP OF RAINFALL AND STRONTIUM-90 CONCENTRATION IN THE MILITARY DIET IN PERU (1959)

Location	Rainfall inches/year	Strontium-90 μμc/gm Ca
Chorillos.....	arid	2.49
Piura.....	arid	1.75
Taena	arid	2.03
Tumbes.....	40	2.53
Arequipa	40	2.72
Puno	60	3.51
Iquitos.....	140	3.36
Average.....	.....	2.63

TABLE 3.—STRONTIUM-90 CONTENT IN MILITARY DIETS IN ECUADOR (1959)

Location	Date	Strontium-90	
		μμc/person/day	μμc/gm Ca
Loja.....	July-August	2.68	3.95
Cuenca ..	July-August	0.52	1.02
Tulcan ..	July-August	1.02	2.82
Quito	July-August	0.59	1.23
Guayoquil	July-August	1.00	1.54
Salinos ...	July-August	1.04	3.00
Machale..	July-August	1.44	3.71
Average	.....	1.18	2.47

STRONTIUM-90 CONTENT IN THE MILITARY DIET IN VIETNAM (1959)[1]

The U. S. Interdepartmental Committee on Nutrition for National Defense has conducted a nutrition survey of the native military population in Vietnam at ten locations to provide information on dietary intakes and nutritional status. In table 1 are presented values on the strontium-90 content of the composite diet collected during the fall months of 1959. The dietary intake of strontium-90 for Vietnam is considerably higher than that reported for the South American countries of Peru and Ecuador (see previous article, page 23). The Vietnam values approach those for the diet of persons living in Cincinnati, Ohio, (average value of Vietnam 8.3 μμc/person/day as compared to 15.4 μμc/person/day in the PHS Cincinnati study as reported in Radiological Health Data, October 1960).

The higher value for Vietnam as compared to Ecuador and Peru is partially the result of larger concentrations of fallout radionuclides. Vietnam lies in the Northern Hemisphere (10-20^{0}N) while Educdor (2^{0}N-4^{0}S) and Lima (4^{0}S-19^{0}S) are primarily in the Southern Hemisphere; consequently, the latter have been subjected to considerably less fallout. A significant and perhaps major factor is the dietary difference between these countries. The rice component of the diet is quite high in Vietnam. The unhulled kernel of rice, as is true in the case of the wheat kernel in the U. S. A., reflects a rather higher concentration of strontium-90 value. This is shown in the value for rice polishings in table 2 of the Vietnam data. The contribution of strontium-90 content in cereal products in Asiatic countries where large amounts of rice are consumed has perhaps a more significant contribution to total diet than that experienced from ingestion of wheat milling products in other countries.

[1]Reported to the U. S. Atomic Energy Commission by Dr. A. R. Schulert, Lamont Geological Observatory, Columbia University in Annual Report dated October 1, 1960. This study was performed through cooperative arrangement between the ICCND and AEC.

TABLE 1.--STRONTIUM-90 CONTENT IN MILITARY DIETS IN VIETNAM (1959)

Location	Date	Strontium-90	
		μμc/day	μμc/gm Ca
Bien Hoa	October 30	5.7	3.5
Dalat	November 16	7.0	10.3
Danang	November 23	19.9	17.0
Duc My	November 11	4.3	13.8
Ho Nai (civilian)	November 6	9.4	6.4
Kontum	November 16	8.5	10.4
Nha Trang	November 9	2.3	7.5
Phong Dinh	December 2	6.3	7.0
Quang Trung*	October 28	2.7	4.4
Quang Trung**	October 29	16.7	13.3
Average daily intake		8.3	9.4

*Polished rice.
**Unpolished rice.

TABLE 2.--STRONTIUM-90 CONTENT IN INDIVIDUAL FOODS OF VIETNAM

(November-December 1959)

Food	Strontium-90 μμc/gm Ca
Rice components--Saigon area:	
Samples from same plot at threshing:	
Total unhulled kernel	26.1
Stalks	47.2
Samples from same mill run:	
Finished polished rice	6.6
Polishings	52.0
Water cress:	
At Dalat	8.4
At Danang	27.4

STRONTIUM-90 CONTENT IN DIET IN VARIOUS COUNTRIES

The following table presents the average daily strontium-90 intake per person in various countries. It must be kept in mind that these are estimates made by the groups noted below. The guide for average daily intake of strontium-90 used by the Department of Health, Education, and Welfare is presently 33 micromicrocuries per kilogram of total dietary intake averaged over a period of one year. In the United States the daily per capita consumption is about 2.2 kilograms. The daily guide for the United States is therefore about 73 μμc of strontium-90.

TABLE 1.--STRONTIUM-90 CONTENT IN DIET IN VARIOUS COUNTRIES (1959)

Country	Strontium-90	
	μμc/day	μμc/gm Ca
Ecuador[a]	1.2	2.5
England[b]	9.8	9.0
Germany[c]	13.0	11.5
Japan[d]	7.8	13.4
Peru[a]	2.8	2.6
United States (Cincinnati, Ohio[e])	15.4	14.0
Vietnam[a]	8.3	9.4

[a]Annual Report to Atomic Energy Commission by Lamont Geological Observatory, Columbia University, Palisades, N. Y., October 1, 1960.

[b]Strontium-90 in Human Diet in United Kingdom--1959. Agricultural Research Council Radiobiological Laboratory.

[c]Report to U. N. Scientific Committee on the Effects of Atomic Radiation. "The Strontium-90 Content of the Diet of Children and Juveniles in 1950" by D. Merten and F. Knopp--Bad Godesberg, Germany--Report II C-6930-1, 14/60 July 20, 1960.

[d]Report of Japanese Government (University of Tokyo) by Yoshio Hiyama, "Annual and Geographical Change of Strontium-90 Dietary Intake of Japanese" (1957-60).

[e]Straub, C. P., G. K. Murthy, and J. E. Campbell, "Radionuclides in Foods"--a paper presented at the Annual Meeting of the Ohio Dietetic Association, Cincinnati, Ohio, May 6, 1960. See also table XII, Estimates of Strontium-90 in United States Diets, Radiological Health Data, October 1960.

SECTION III.—MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The original Public Health Service Milk Monitoring Program consisted of 12 sampling stations. This is being expanded to include an additional 60 stations, of which 58 submitted samples for August. Since the sampling procedures for the original and the added stations are somewhat different, they will be described and reported separately. The Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, continues to conduct the analyses for the original network stations; the Public Health Service Southeastern Radiological Health Laboratory at Montgomery, Alabama, and the Southwestern Radiological Health Laboratory at Las Vegas, Nevada, provide this service for the added stations.

Publication of the data will normally follow about four months after collection of samples because of the time required for shipment, processing, decay product build-up, compilation of the data, clearance and publication procedures.

Original Stations

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing because it is among the most important components of the diet and is available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs. Since this program has been in operation for over three years, its contribution of information is significant.

Selection of the original sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.

2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.

3. The milk samples were from a supply that was part of a metropolitan milkshed.

4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000-cow minimum requirement but have been included because they are part of the monitoring program around the Nevada Test Site.

One-gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center for radionuclide analysis. It is estimated that these samples represent 2,000-gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured, when present in the milk, by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, the strontium-90 being calculated by measuring the build-up in a two-week period of the daughter decay product, yttrium-90, using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, pp. 225-235, Feb. 1959.

April through September 1960 issues of Radiological Health Data list references for technical descriptions of the methodology of analyses used.

August data for the original stations are presented in table 1.

Added Stations

The Milk Monitoring Program has been expanded to provide additional information on levels of radioactivity in milk consumed by the public. The new stations are being established in cooperation with State and local health and milk sanitation agencies. The cities have been selected in order to provide adequate coverage from the combined viewpoints of production areas and consuming population. The emphasis on this expanded sampling and radioassay program is that of:

1. Measuring the radioactivity levels of the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the point of distribution to the public.

2. Providing one sampling point within each state with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of larger population groups. This differs from the original set of sampling stations whose selection was based principally upon certain criteria involving the milk production and milkshed area characteristics.

In some instances the designated points are the same as those which reported originally. The establishment of the added sampling stations does not preclude the need for further samples from the selected milksheds serving the same cities. It is important that both networks be in operation for a sufficient period of time to provide an overlap for purposes of comparative study.

The sampling procedure has been developed to give a sample from one day's sales per month in a community which will be as representative of the total supply as can be achieved under practical conditions. The sample will be a composite of those plants supplying not less than 90 percent of the city's milk supply. The contribution from each plant to the total sample will be approximately proportional to volume of milk sold.

The samples from the added stations are collected with the assistance of the various State and local health and milk sanitation agencies and shipped for analysis to either the Southwestern or Southeastern Radiological Health Laboratory. The Southeastern Radiological Health Laboratory processes samples from the 30 states generally east of the Mississippi, and the Southwestern Radiological Health Laboratory processes samples from the western states

At the present time radioassays for Sr^{89}, Sr^{90} and Cs^{137} are being performed. Other radionuclides of concern to public health agencies will be included for assay as necessary for complete monitoring of the milk supply.

Data from the Southwestern Radiological Health Laboratory and the Southeastern Radiological Health Laboratory for August 1960 are presented in table 2.

TABLE 1.—RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Robert A. Taft Sanitary Engineering Center

August 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	August	Yearly average	August	Yearly average	August	Yearly average	August	Yearly average	August	Yearly average	August	Yearly average
Atlanta, Georgia	1.06	1.12	ND	<10	ND	<5	13	15	ND	<10	20	48
Austin, Texas	1.05	1.09	ND	<10	ND	<5	3	5	ND	<10	15	21
Chicago, Illinois	1.01	1.09	ND	<10	ND	<5	8	9	ND	<10	15	36
Cincinnati, Ohio	1.06	1.12	ND	<10	ND	<5	10	11	ND	<10	10	28
New York, New York	1.04	1.07	ND	<10	ND	<5	8	9	ND	<10	10	32
Sacramento, Calif.	1.09	1.09	ND	<10	ND	<5	4	4	ND	<10	5	14
Salt Lake City, Utah	1.06	1.10	ND	<10	ND	<5	5	7	ND	<10	10	35
Spokane, Washington	1.10	1.11	ND	<10	ND	<5	9	12	ND	<10	25	49
St. Louis, Missouri	1.10	1.23	ND	<10	ND	<5	16	20	ND	<10	10	37

Samples are taken at one sampling point from the milk supply of the areas listed above.
ND—No detectable activity.

TABLE 2.--RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program

Added Stations--August 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Strontium-89		Strontium-90		Cesium-137	
	August	Average to date[1]	August	Average to date[1]	August	Average to date[1]	August	Average to date[1]
Atlanta, Ga.	1.20	1.20	ND	<5	11	11	<10	<10
Albuquerque, N. M.	1.05	1.14	ND	<5	3	4	-	-
Austin, Tex.	1.16	1.12	ND	<5	1	2	<10	10
Baltimore, Md.	0.97	0.97	ND	<5	6	6	<10	<10
Boston, Mass.	1.19	1.16	ND	<5	10	14	20	30
Buffalo, N. Y.	1.10	1.21	ND	<5	6	7	<10	10
Burlington, Vt.	1.18	1.17	ND	<5	7	10	<10	20
Charleston, S. C.	1.20	1.20	ND	<5	10	10	20	20
Charleston, W. Va.	-	1.16	ND	<5	8	10	<10	10
Charlotte, N. C.	1.22	1.17	ND	<5	5	12	<10	10
Chicago, Ill.	1.08	1.06	ND	<5	6	7	<10	<10
Cincinnati, Ohio	1.14	1.14	ND	<5	9	9	<10	<10
Cleveland, Ohio	1.18	1.06	ND	<5	8	8	10	<10
Dallas, Tex.	1.19	1.23	ND	<5	5	6	<10	<10
Denver, Colo.	1.03	1.14	ND	<5	5	7	-	-
Detroit, Mich.	1.19	1.10	ND	<5	6	7	<10	<10
Des Moines, Iowa	0.98	1.06	ND	<5	7	8	-	20
Grand Rapids, Mich.	-	1.18	ND	<5	6	8	<10	<10
Hartford, Conn.	1.16	1.15	ND	<5	10	9	10	20
Helena, Mont.	1.08	1.08	ND	<5	4	6	-	25
Honolulu, Hawaii	1.06	1.06	ND	<5	6	4	-	40
Idaho Falls, Idaho	0.98	1.07	ND	<5	3	5	-	40
Indianapolis, Ind.	1.18	1.14	ND	<5	6	6	<10	<10
Jackson, Miss.	1.23	1.23	ND	<5	14	14	<10	<10
Kansas City, Mo.	1.07	1.10	ND	5	6	8	-	-
Laramie, Wyo.	1.04	1.07	ND	<5	6	5	-	-
Las Vegas, Nev.	1.02	1.09	ND	<5	2	3	-	-
Little Rock, Ark.	1.20	1.20	ND	<5	10	10	<10	<10
Louisville, Ky.	1.21	1.18	ND	<5	10	8	10	<10
Manchester, N. H.	1.18	1.22	ND	<5	10	13	30	40
Milwaukee, Wis.	1.20	1.13	ND	<5	4	6	<10	<10
Minneapolis, Minn.	0.95	0.95	ND	<5	10	10	-	-
New Orleans, La.	1.28	1.16	ND	<5	14	16	<10	10
New York, N. Y.	1.10	1.10	ND	<5	8	10	<10	10
Norfolk, Va.	1.20	1.14	ND	<5	10	10	<10	<10
Oklahoma City, Okla.	1.17	1.14	ND	<5	8	8	<10	<10
Omaha, Nebr.	1.05	1.05	ND	<5	9	9	-	-
Palmer, Alaska	1.01	1.08	ND	<5	8	7	-	30
Philadelphia, Pa.	1.07	1.13	ND	<5	10	10	<10	20
Phoenix, Ariz.	1.00	1.01	ND	<5	4	4	-	15
Pittsburgh, Pa.	-	1.23	ND	<5	10	14	<10	20
Portland, Maine	1.14	1.12	ND	<5	10	14	30	35
Portland, Oreg.	1.04	1.09	ND	5	10	11	-	70
Providence, R. I.	1.18	1.15	ND	<5	11	14	10	20
Sacramento, Calif.	1.04	1.04	ND	<5	3	3	-	-
Salt Lake City, Utah	1.08	1.11	ND	<5	4	6	-	-
San Francisco, Calif.	1.07	1.09	ND	<5	3	5	-	20
San Juan, P. R.	1.15	1.10	ND	<5	4	4	<10	<10
Seattle, Wash.	1.04	1.09	ND	5	8	9	-	60

See footnotes at end of table.

TABLE 2.--RADIOACTIVITY IN MILK--Con.

Public Health Service Milk Monitoring Program

Added Stations--August 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Strontium-89		Strontium-90		Cesium-137	
	August	Average to date[1]	August	Average to date[1]	August	Average to date[1]	August	Average to date[1]
Spokane, Wash.	1.04	1.08	ND	<5	5	8	-	-
St. George, Utah	0.95	0.95	ND	<5	5	5	-	-
St. Louis, Mo.	0.98	0.96	ND	<5	6	6	-	-
Syracuse, N. Y.	1.14	1.23	ND	<5	6	7	20	20
Tampa, Fla.	1.22	1.22	ND	<5	4	4	80	80
Trenton, N. J.	1.14	1.17	ND	<5	7	8	<10	10
Washington, D. C.	1.15	1.10	ND	<5	8	9	<10	10
Wichita, Kansas	0.98	1.08	ND	<5	7	6	-	-
Wilmington, Del.	1.37	1.21	ND	<5	7	9	<10	20

ND--No detectable activity.

[1] Because this program was initiated in 1960 and sampling stations necessarily become operative in a staggered sequence, the averages shown represent all samples taken to date. Averages will normally be for the latest 12 month period after sampling began. For the August data, the average covers a period of one to six months.

STRONTIUM-90 IN NORTH AMERICAN MILK

Lamont Geological Observatory
Columbia University

As a part of its contract with the Atomic Energy Commission, the Lamont Geological Observatory has continued its study of the concentration of strontium-90 in milk. The Los Alamos Scientific Laboratory's powdered milk program for cesium-137 determinations provides milk samples to Lamont for strontium-90 analysis. Additional samples are obtained by the Lamont group.

The following table presents a summary of averages of strontium-90 in North American Milk. Results of analyses conducted by the Public Health Service, Consumers Union and Health and Safety Laboratory, Atomic Energy Commission, are also included in this tabulation.

TABLE 1.--SUMMARY OF AVERAGES OF STRONTIUM-90 IN NORTH AMERICAN MILK

(μμc/gm calcium)

Area	1957	1958	1959	1960*
Eastern U. S. (40-60 inches rainfall)	6.5	8.7	11.2	9.4
Central States, Eastern Canada (20-40 in. rainfall)	6.4	7.5	9.2	9.8
Great Plains States (10-30 in. rainfall)	6.1	8.7	11.4	8.1
Desert Areas (5-15 in. rainfall)	2.5	3.4	6.0	3.0
Northwest Coast (30-60 in. rainfall)	4.6	6.8	11.7	8.6
U. S.-Canada Average--weighted for population	6.2	8.1	10.7	≈ 7

*First half of 1960.

CESIUM-137 IN PEOPLE AND MILK IN THE UNITED STATES

Los Alamos Scientific Laboratory
U. S. Atomic Energy Commission

Studies of cesium-137 in people and milk performed by the Los Alamos Scientific Laboratory during 1959 and early 1960 were reported previously.[1] Data have now been reported for April–August 1960.[2] Extreme values observed during this period are summarized below.

TABLE 1.—CESIUM-137 IN PEOPLE AND MILK IN THE U. S.

(Concentrations in uuc Cs^{137}/gm potassium)

Samples	Late 1959-early 1960	April-August 1960
Highest Cs^{137} in milk.....	114	84
Lowest Cs^{137} in milk.....	5	0.03
Highest Cs^{137} in people....	113	150
Lowest Cs^{137} in people,...	42	10

[1] AEC Health and Safety Laboratory Reports, HASL-77, HASL-88, and summarized in Radiological Health Data, October 1960.

[2] AEC Health and Safety Laboratory Report, HASL-95, October 1, 1960.

SECTION IV.—WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provision of Section 4 (c) of Public Law 660, which states "...The Surgeon General shall ... collect and disseminate basic data ... (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. At present there are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing, beta activity in most raw waters is generally approaching a level attributable solely to natural beta activity. Natural beta activity can be two or three times the natural alpha activity based on the same nuclides being present. Some exceptions to this are seen, notably the data for the Columbia River and the Animas River. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than one week. Beginning with samples taken in January 1960, beta determinations were performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

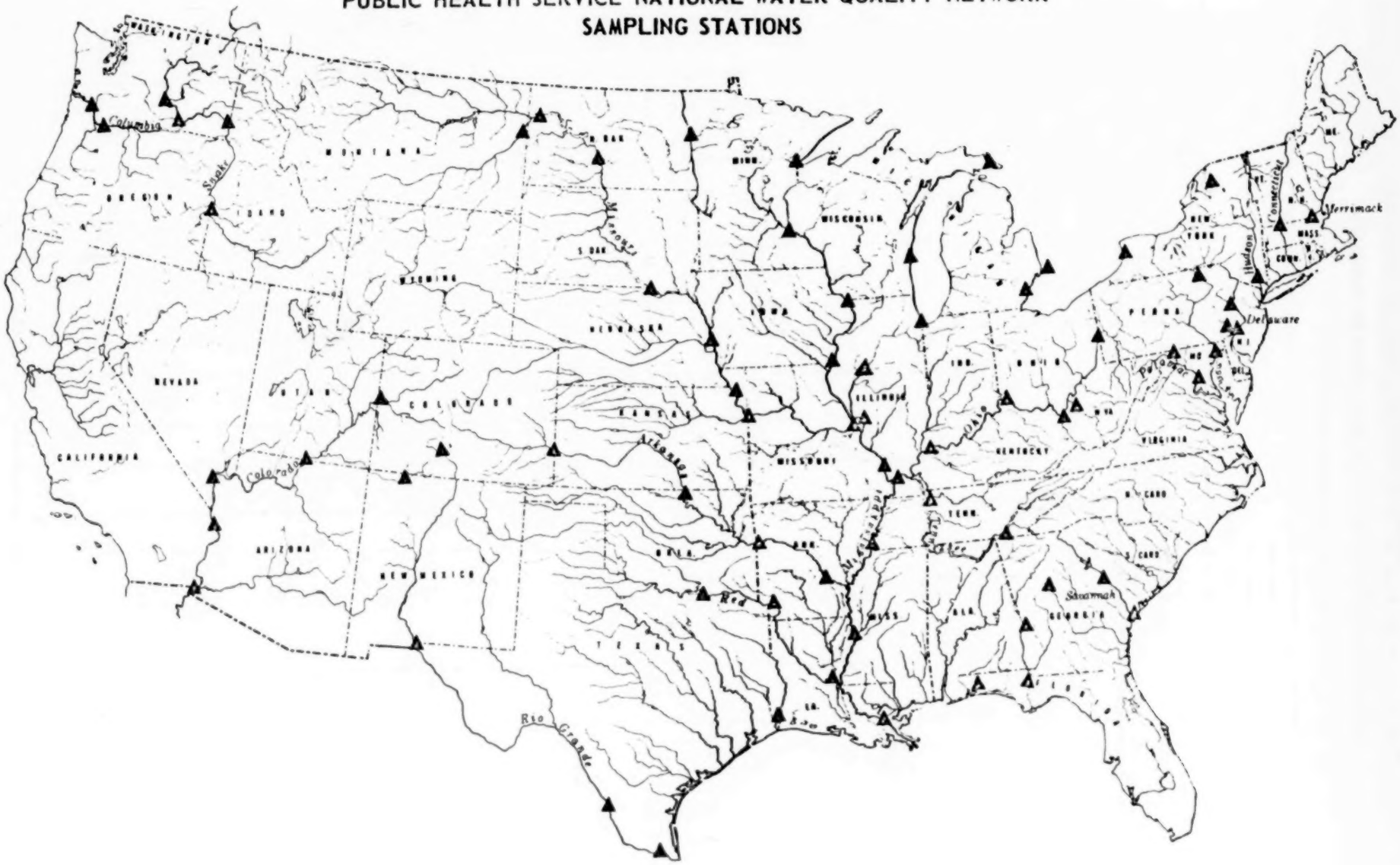
Strontium-90 data are reported as being the results of determinations on composite samples for a three-month period ending in the month shown.

Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167-169.

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK
SAMPLING STATIONS



As of June 30, 1960

FIGURE 1

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending June 30, 1960	July 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ANIMAS RIVER							
Cedar Hill, N. Mex.	0.3	2	9	11	1	11	12
ARKANSAS RIVER							
Coolidge, Kans.	1.1	-	-	-	-	-	-
Ponca City, Okla.	1.3	0	14	14	3	7	10
Fort Smith, Ark.	1.1	85	<1	86	-	-	-
Pendleton Ferry, Ark.	1.2	57	3	60	0	0	0
CHATTAHOOCHIE RIVER							
Atlanta, Ga.	(*)	0	<1	<1	0	0	0
Columbus, Ga.	0.5	0	0	0	3	0	3
COLORADO RIVER							
Loma, Colo.	0.3	0	0	0	1	13	14
Page, Ariz.	0.9	30	18	48	19	10	29
Hoover Dam, Ariz.-Nev.	1.3	0	1	1	0	9	9
Parker Dam, Ariz.-Calif.	0.4	-	-	-	-	-	-
Yuma, Ariz.	1.0	0	<1	<1	0	6	6
COLUMBIA RIVER							
Pasco, Wash.	0.3	16	98	114	0	<1	<1
Wenatchee, Wash.	0.3	0	0	0	0	0	0
Bonneville Dam, Ore.	(*)	18	158	176	-	-	-
Clatskanie, Ore.	0.3	-	-	-	-	-	-
DELAWARE RIVER							
Martin's Creek, Pa.	0.4	0	0	0	-	-	-
Philadelphia, Pa.	0.3	0	0	0	4	0	4
GREAT LAKES							
Gary, Ind.	(*)	0	0	0	0	0	0
Duluth, Minn.	0.3	0	0	0	0	0	0
Detroit, Mich.	0.6	<1	0	<1	0	0	0
Buffalo, N. Y.	0.7	0	12	12	-	-	-
HUDSON RIVER							
Poughkeepsie, N. Y.	0.7	0	4	4	-	-	-
ILLINOIS RIVER							
Peoria, Ill.	0.8	2	2	4	1	2	3
KANAWHA RIVER							
Winfield Dam, W. Va.	0.3	0	0	0	0	<1	<1
MISSISSIPPI RIVER							
Red Wing, Minn.	1.5	0	1	1	-	-	-
Dubuque, Iowa	(*)	1	5	6	<1	<1	1

*Insufficient sample for analysis.

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Con.

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending June 30, 1960	July 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
MISSISSIPPI RIVER—Con.							
East St. Louis, Ill.	1.2	2	8	10	5	0	5
Cape Girardeau, Mo.	0.9	4	4	8	-	-	-
West Memphis, Ark.	0.9	0	2	2	5	1	6
Delta, La.	(*)	0	0	0	-	-	-
New Orleans, La.	1.0	7	5	12	3	1	4
MISSOURI RIVER							
Williston, N. D.	0.7	2	15	17	2	4	6
Bismarck, N. D.	0.9	-	-	-	-	-	-
Yankton, S. D.	1.0	0	8	8	6	3	9
Omaha, Nebr.	0.6	4	<1	4	6	4	10
St. Joseph, Mo.	0.9	75	16	91	-	-	-
Kansas City, Kans.	0.9	86	24	110	-	-	-
St. Louis, Mo.	1.0	45	35	80	6	3	9
OHIO RIVER							
East Liverpool, O.	1.9	0	1	1	0	0	0
Wheeling, W. Va.	-	<1	<1	1	<1	0	<1
Huntington, W. Va.	0.3	0	12	12	0	0	0
Cincinnati, O.	0.6	5	27	32	4	0	4
Evansville, Ind.	0.4	8	0	8	7	0	7
Cairo, Ill.	0.7	6	4	10	3	4	7
POTOMAC RIVER							
Williamsport, Md.	0.8	0	1	1	-	-	-
Great Falls, Md.	0.5	0	0	0	-	-	-
RED RIVER							
Denison, Tex.	1.2	0	0	0	1	0	1
Index, Ark.	1.2	0	44	44	-	-	-
Alexandria, La.	0.7	-	-	-	-	-	-
RIO GRANDE RIVER							
El Paso, Tex.	1.4	0	0	0	<1	2	2
Laredo, Tex.	1.0	112	59	171	59	1	60
Brownsville, Tex.	0.7	0	0	0	<1	2	2
SABINE RIVER							
Ruliff, Tex.	(*)	2	1	3	1	0	1
ST. CLAIR RIVER							
Port Huron, Mich.	(*)	0	5	5	0	0	0
ST. LAWRENCE RIVER							
Massena, N. Y.	0.6	0	2	2	0	<1	<1
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.4	2	0	2	0	0	0

*Insufficient sample for analysis.

TABLE 1.–RADIOACTIVITY IN RAW SURFACE WATERS–Con.

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending June 30, 1960	July 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
SCHUYLKILL RIVER							
Philadelphia, Pa.	0.7	0	0	0	0	0	0
SAVANNAH RIVER							
North Augusta, S. C.	(*)	0	1	1	-	-	-
Port Wentworth, Ga.	0.8	1	6	7	0	0	0
SNAKE RIVER							
Wawawai, Wash.	0.3	0	0	0	-	-	-
Weiser, Idaho	0.5	0	4	4	0	2	2
SUSQUEHANNA RIVER							
Sayre, Pa.	0.4	0	0	0	<1	0	<1
Conowingo, Md.	0.2	0	8	8	0	0	0
TENNESSEE RIVER							
Chattanooga, Tenn.	1.3	0	54	54	0	0	0
YELLOWSTONE RIVER							
Sidney, Mont.	0.3	4	6	10	1	2	3

*Insufficient sample for analysis.

MONITORING OF WATER SUPPLIES AROUND THE NEVADA TEST SITE

By contract with the Atomic Energy Commission the Public Health Service has conducted an off-site monitoring program around the Nevada Test Site since 1955. Included in the program have been measurements of radioactivity in water supplies. These data have been reported in the Atomic Energy Commission's 13th, 14th, 18th and 23rd Semiannual Reports to Congress and by the Public Health Service in the 1957 Congressional Hearings, "The Nature of Radioactive Fallout and Its Effects on Man."

Figure 1 summarizes the data on radioactivity (gross beta) in water supplies for the two-month period, July-August 1960.

The lower limit of detectability with the equipment used is about 10 micromicrocuries per liter.

TABLE 1.--DESCRIPTION OF WATER SAMPLING POINTS

Nevada Test Site

Location	Source	Population served
Las Vegas	13 wells--650 to 1,250' depth plus Lake Mead supply.	40,000
Game Reserve	400' drilled well	20
Indian Springs	600' drilled well	Average 250
Pahrump	75' driven well	10-50
Ash Meadows	Spring 25' deep	8
Lathrop Wells	3 wells--600' deep	Average 15
Beatty	Spring	550
Lida Junction	125' drilled well	2-10
Goldfield	Spring	Average 200
Tonapah	2 drilled wells--60' depth	Average 1,500
Warm Springs	Multiple springs--no improvement	10
Diablo	Well	State Highway Station
Lincoln Mine	2 driven wells	3
Caliente	Springs	Average 10-12
Crystal Springs	Free flowing spring	0
Alamo	2 wells--50-67' deep	Average 175
Pahranagat Lake	Surface	Not used for domestic purposes
Butler Ranch	Flowing spring	1
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool
Logandale	Drilled well	300
Ballistic Range	Drilled well	10-15

GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE FOR July-August 1960

(μμc/liter at count time)

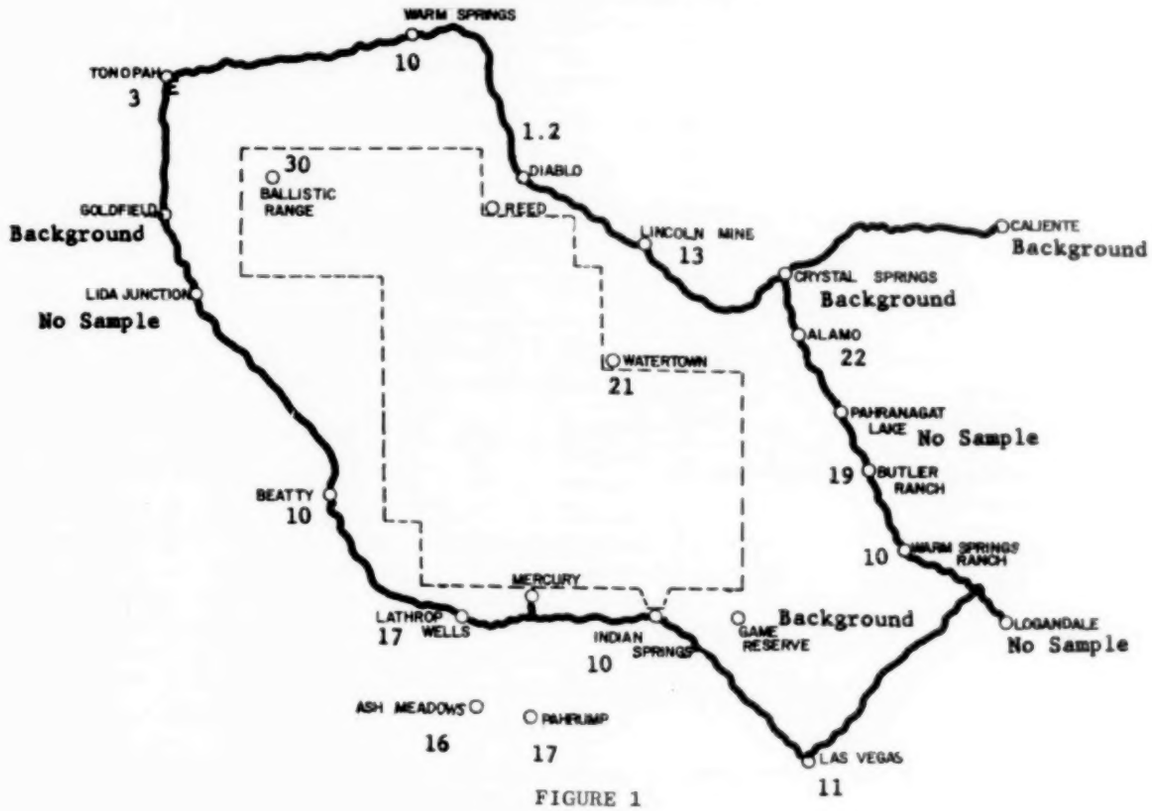


FIGURE 1

SECTION V.—OTHER DATA

EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variance anticipated due to differences in normal background and in instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

August 1960

Station location	Average* mr/hr	Station location	Average* mr/hr
Alaska, Anchorage	0.01	Mississippi, Pascagoula	(**)
Alaska, Fairbanks	(**)	Missouri, Jefferson City	0.01
Alaska, Juneau	0.02	Montana, Helena	0.03
Arizona, Phoenix	0.01	New Jersey, Trenton	0.02
Arkansas, Little Rock	0.02	New Mexico, Santa Fe	0.04
California, Berkeley	0.01	New York, Albany	0.02
California, Los Angeles	0.01	North Carolina, Gastonia	0.02
Colorado, Denver	0.02	Ohio, Cincinnati	(**)
Connecticut, Hartford	0.01	Oklahoma, Oklahoma City	0.02
District of Columbia	0.02	Oklahoma, Ponca City	0.04
Florida, Jacksonville	0.02	Oregon, Portland	0.01
Georgia, Atlanta	0.02	Pennsylvania, Harrisburg	0.01
Hawaii, Honolulu	0.02	Rhode Island, Providence	0.02
Idaho, Boise	0.02	South Carolina, Columbia	0.02
Illinois, Springfield	0.01	South Dakota, Edgemont	(**)
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.02	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.01	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02
Minnesota, Minneapolis	0.01		

*Readings taken 3 feet above ground.
No data received.

ARGONNE NATIONAL LABORATORY SOIL DATA

U. S. Atomic Energy Commission

Fission product radioactivity at the Argonne National Laboratory, Lemont, Illinois for July and August, 1960 has been reported by Dr. Philip F. Gustafson. Previous data were reported in the July and December 1960 Radiological Health Data.

Isotope	July 1960 mc/mi^2	August 1960 mc/mi^2
Zr^{95} Nb^{95}.....	30	0
Cs^{137}.....	183	174
Ru^{106}.....	790	740
Ce^{144}.....	1,160	1,150
Totals.....	2,163	2,064
Dose-rate (urads/hr)*.....	1.53	1.28

*Calculated dose-rate at one meter above ground surface. No correction is made for shielding effect of structures.

STRONTIUM-90 CONCENTRATION IN HUMAN BONE FROM ALASKA[1]

Strontium-90 analyses of Eskimo and Indian bone samples collected in Alaska, are conducted by Columbia University's Lamont Geological Observatory, Palisades, N. Y. The samples were obtained through the cooperation of the Public Health Service Hospital at Anchorage.

Only one of the first six samples analysed—bones from a Fort Yukon Indian—showed a lower strontium-90 content than the world average. Wide fluctuations in the bone content of strontium-90 among these people are anticipated because of the extreme fluctuations of strontium-90 concentrations in the native diet (see Table 1, page 30 for strontium-90 concentrations in Alaskan food samples).

Table 1 shows the concentrations of strontium-90 in human bone samples from this area which have been analyzed to date.

TABLE 1.—STRONTIUM-90 CONCENTRATION IN ALASKAN BONE SAMPLES

December 1959—May 1960

Age	Sex	Race	μμc/gm Ca
4 months	M	Eskimo	2.42
7 years	M	Eskimo	3.35
25 years	M	Indian	0.18
26 years	F	Eskimo	1.94
53 years	M	Eskimo	0.47
61 years	M	Indian	0.59

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[1]Reported to the U. S. Atomic Energy Commission by Dr. A. R. Schulert, Lamont Geological Observatory, Columbia University in "Annual Report" dated October 1, 1960.

STRONTIUM-90 ACTIVITY IN HUMAN BONE

Lamont Geological Observatorv. Columbia University

Under contract with the Atomic Energy Commission the Lamont Geological Observatory has continued its program to study the concentration of strontium-90 in human bone.[1] New data have recently been reported. Past studies of this group have been published in the AEC Quarterly Statement on Fallout, January, 1960 and Radiological Health Data, May and July, 1960. A summary of human bone data for the period 1958-59 is presented below. Information on the specific bone examined is not available.

TABLE 1.--SUMMARY OF HUMAN BONE DATA 1958-59

($\mu\mu$c Sr^{90}/gm Ca)

Age-Years	Area				
	Africa	Asia	Europe	No. America	So. America
Fetus.....	-	0.47(1)*	-	<0.3-2.2(91)	-
0-4	-	-	<0.4(1)	<0.4-3.35(6)	<0.09-1.7(36)
5-9.....	0.3-<0.5(2)	-	1.02-1.32(2)	<0.3-<0.4(2)	<0.2-0.32(6)
10-19.....	<0.1-0.56(10)	0.95(1)	-	<0.2-3.7(16)	<0.1-1.0(26)
Adults.....	<0.1-0.37(2)	<0.07-0.86(8)	0.12-0.19(5)	0.3-1.94(17)	<0.05-0.36(10)

*The number of samples in each group is shown in parenthesis.

ENVIRONMENTAL LEVELS OF RADIOACTIVITY AT ATOMIC ENERGY COMMISSION INSTALLATIONS

The United States Atomic Energy Commission provides data on the environmental levels of radioactivity in the vicinity of major Commission installations to the Public Health Service on a quarterly basis.

The November and December 1960 issues of Radiological Health Data summarized the 1959 and the first quarter reports for 1960 for fifteen installations. Second quarter 1960 reports for four of these installations are included in the following section.

BETTIS ATOMIC POWER LABORATORY

Westinghouse Electric Corporation
Pittsburgh, Pennsylvania

September 1, 1960

Environmental levels of radioactivity at the Bettis Atomic Power Laboratory for 1959 and first quarter of 1960 were reported in the November 1960 issue of the Radiological Health Data. The following report presents the data for the second quarter of 1960.

The Bettis Atomic Power Laboratory (BAPL), operated for the Atomic Energy Commission (AEC) by the Westinghouse Electric Corporation, was established in 1949 and since that time has been engaged in research and development work related to naval atomic propulsion systems and the central station atomic power reactor at Shippingport.

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[1]Annual Report to the AEC, "Deposition of Neclear Fallout Debris," A. R. Schulert, et al, Lamont Geological Observatory, Columbia University, Palisades, New York, October 1, 1960.

The data in this report indicates the levels of environmental radioactivity measured at the environs of BAPL. Figures 1 and 2 show the location of the laboratory in relation to the surrounding community and the locations at which the various kinds of environmental samples are collected.

Measurements are made continually to insure that controls on laboratory processes are adequate to prevent the release of radioactive materials to the surrounding community. Measurements are also made continually in the area surrounding the laboratory to determine background levels of radioactivity. Results of these measurements have shown that laboratory controls have been effective in minimizing the release of radioactivity to the environment.

Liquid Waste Activity

The liquid effluent from the Laboratory is sampled continually and a composite sample collected and analyzed weekly. This measured concentration may include fallout from rainfall and runoff that has entered the effluent line through the laboratory drainage system.

Radioactivity levels in liquid wastes discharged during the second quarter of 1960 are summarized below.

TABLE 1.—GROSS RADIOACTIVITY IN LIQUID WASTE

(Average concentrations in μμc/liter)

Periods	Gross Radioactivity
April 1960.....	160
May 1960.....	290
June 1960.....	92
Second quarter 1960	170

The concentration of strontium-90 in the liquid effluent is shown below. Data for the third and fourth quarters of 1959 and the first quarter of 1960 are reported here, since these were not available when the report for the first quarter was issued.

TABLE 2.—STRONTIUM-90 IN LIQUID WASTE

(Average concentrations in μμc/liter)

Periods	Strontium-90
Third quarter 1959.....	2.1
Fourth quarter 1959.....	1.8
First quarter 1960	0.9
Second quarter 1960.....	Analysis not completed

External Beta-Gamma Background Radiation Levels

Beta-gamma background radiation levels are monitored continuously and recorded at a monitoring station located on the western boundary of BAPL property as shown by figure 2. The average level for the second quarter of 1960 was 0.016 millirads per hour. This value is very similar to the first quarter average and within the range of background radiation levels measured by the AEC in 1957 throughout the United States.

Fallout Activity

Radioactive fallout is collected at six stations located at the periphery of BAPL property as shown on figure 2. The measurements of radioactive fallout collected by these stations provide only approximate values indicative of trends or variations. Due to their locations, these stations measure not only day-to-day fallout from the atmosphere, but may also detect fallout present in dust created by the movement of vehicles and construction work in the immediate vicinity.

The following table shows the data obtained from analyses of samples collected weekly at these stations during the second quarter of 1960.

TABLE 3.--GROSS BETA RADIOACTIVITY IN FALLOUT

(Average amounts in mc/mi^2/month)

Periods	Stations upwind		Stations downwind			
	No. 1	No. 5	No. 2	No. 3	No.4	No. 6
April 1960.....	8	7	8	6	7	6
May 1960.....	4	5	6	7	6	4
June 1960.....	4	3	4	4	3	3
Second quarter 1960.....	5	5	6	6	5	4

Based on prevailing wind directions, the sampling locations have been categorized as upwind or downwind and the data compared in an effort to determine what effect laboratory operations have on the fallout in surrounding areas. The above results reveal no significant differences to indicate the laboratory is contributing to radioactive fallout. Average concentrations of radioactive fallout measured during the second quarter were very similar to the average concentrations measured during the first quarter of 1960.

Soil Sampling

Soil samples from five locations on the perimeter of the laboratory are collected each year during the second and fourth quarters (see figure 2 for sampling locations). Average concentrations of radioactivity in the soil samples were 17uuc/gram of alpha and 26 uuc/gram of beta. These values are slightly lower, but not significantly different from the average concentrations of radioactivity measured in the soil during 1959.

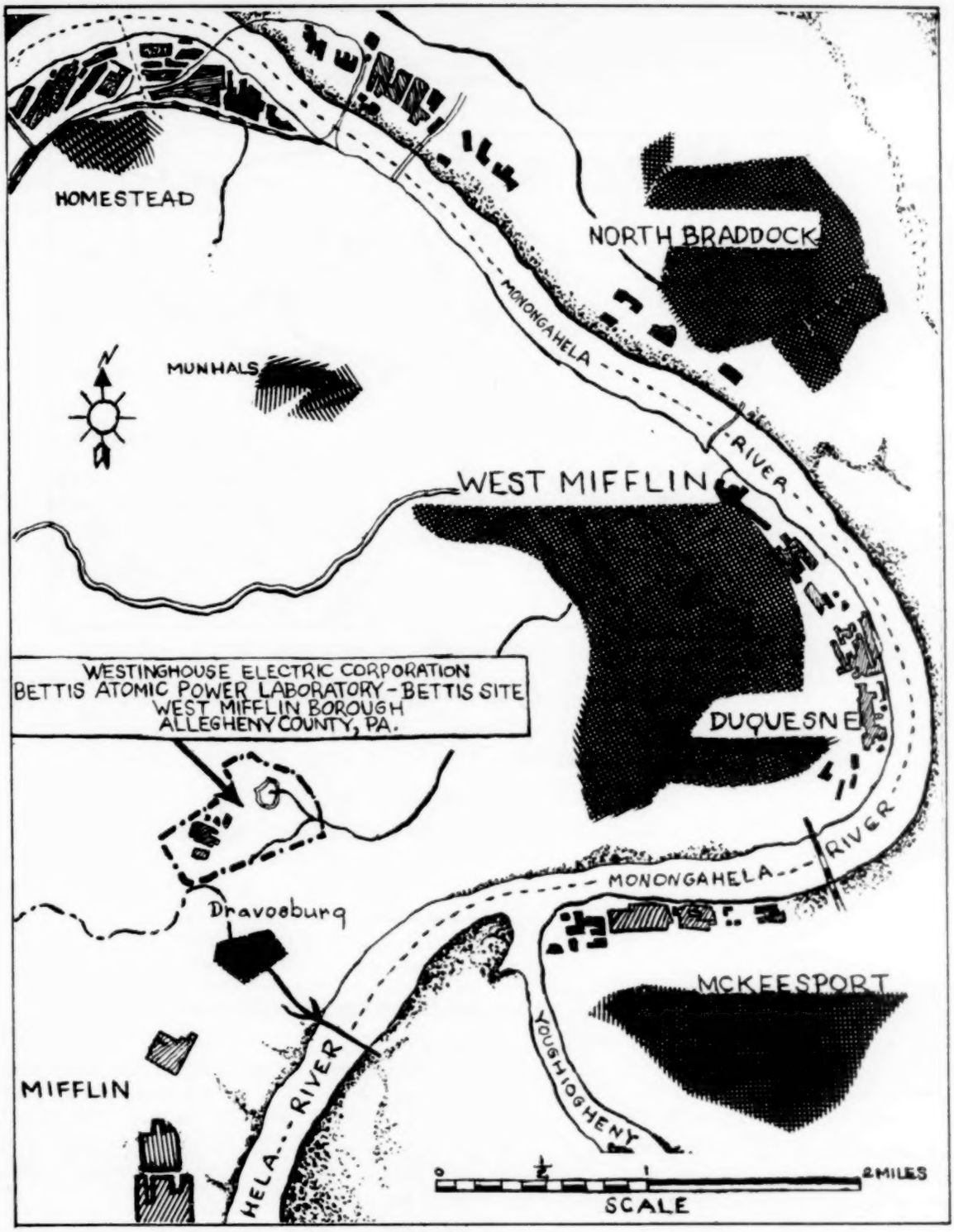

FIGURE 2

Sampling Station Locations

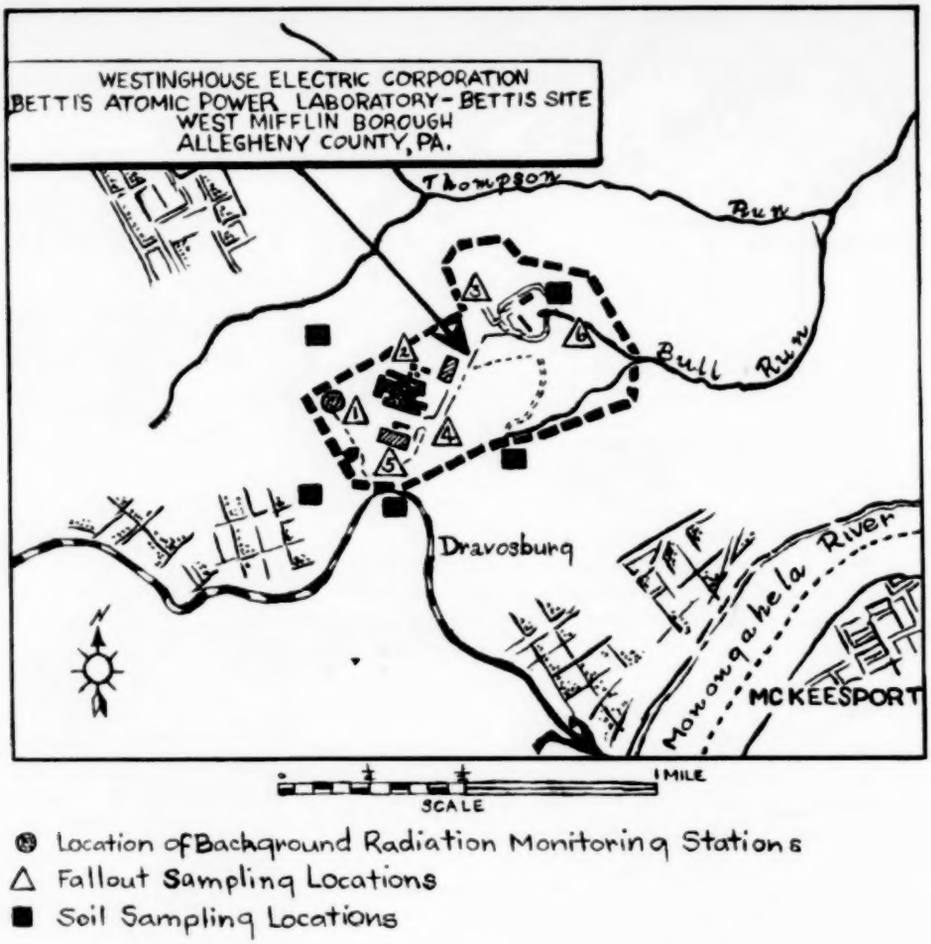

FIGURE 1

Bettis Atomic Power Laboratory and Surrounding Area

KNOLLS ATOMIC POWER LABORATORY

General Electric Company
Schenectady, New York

August 1960

Environmental levels of radioactivity at Knolls Atomic Power Laboratory (KAPL) for 1959 and first quarter of 1960 were reported in the December 1960 issue of Radiological Health Data. The following report presents a summary of the data for the second quarter of 1960.

The principal task of KAPL is to support the Naval Reactors Program of the Atomic Energy Commission in the development of nuclear power reactors for naval propulsion. The General Electric Company has been the operator of KAPL for the Atomic Energy Commission since 1946.

The Knolls Atomic Power Laboratory consists of two sites, the Knolls Site and the West Milton Site. The former is located five miles east of Schenectady, New York, on the south bank of the Mohawk River. The West Milton Site is located approximately 18 miles north of Schenectady, in Saratoga County.

Small amounts of radioactive materials are released to both the atmosphere and to two surface streams in the area—the Mohawk River at the Knolls Site and the Glowegee Creek at the West Milton Site. Prior to the release of this low level radioactivity to the environment, all KAPL liquid waste and exhaust air systems are carefully and continuously monitored. In addition to the in-plant control monitoring, an environmental monitoring program is conducted both on and off-site.

KAPL environmental monitoring locations are given in the attached figure. A brief description of the types of samples collected at the various locations is given in the referenced legend.

Liquid Radioactive Waste

West Milton Site

The amounts of radioactivity discharged from the West Milton Site as well as the results of the river sampling are presented in table 1. Alpha analyses are not performed since no alpha radioactivity is discharged from the West Milton Site.

TABLE 1.—GROSS BETA RADIOACTIVITY DISCHARGED AND DETECTED IN GLOWEGEE CREEK

Period 1960	Total waste discharged millicuries	Average concentration discharged μμc/liter	Average concentration in creek	
			Upstream μμc/liter	Downstream μμc/liter
April	0.58	130	9	3
May	0.26	98	3	4
June	0.43	100	8	7
Second quarter	1.27	110	7	5

Precipitation has a variable effect upon the Glowegee Creek samples which is dependent upon the amount of rainfall, creek flow and the period of sampling relative to the period of precipitation. The results of precipitation sampling are in the following table.

TABLE 2.—GROSS BETA RADIOACTIVITY IN PRECIPITATION 1960

(Average concentration in μμc/liter)

Period	Activity
April	153
May	73
June	77
Second quarter	103

Knolls Site

A continuous proportional sample of the Knolls Site combined sewer effluent is taken at the point of discharge to the Mohaw River. Analyses of weekly composite samples are made for radiochemical and toxic chemical content and these analyses show that strontium-90 is the principal component which has to be considered in hazard control. The radioisotopic average content of the combined sewer effluent for the second quarter of 1960 is presented in the following table.

TABLE 3.—RADIOACTIVITY CONTENT OF THE KNOLLS SITE WASTE EFFLUENT

Second Quarter 1960

Radioisotope	Percent abundance	Average concentration μμc/liter
Ce^{144}, Pr^{144}	22.0	660
Sr^{89}	18.6	560
Sr^{90}	15.7	470
I^{131}	2.0	60
Ru^{106}	1.0	30
Cs^{137}	30.0	900
Zr^{95}, No^{95}	1.0	30
Total	90.3	

Knolls Site effluent is monitored continuously for alpha radioactivity. Since the quarterly discharge rate was less than 1% of the most restrictive environmental limit for alpha (Pu^{239}), the data are not reported.

Mohawk River water is sampled at locations upstream and downstream from the Knolls Site. The sample locations are: (1) at the General Electric Company Powerhouse eight miles upstream from the Knolls Site (a continuous sample after May 1959), (2) at the point of discharge to the Mohawk River from the Knolls Site (a continuous sample), (3) at the Vischer Ferry Powerhouse approximately two miles downstream (a continuous sample) and (4) at the City of Cohoes Pumping Station approximately thirteen miles downstream (a weekly grab sample).

The amounts of radioactive liquid waste discharged from the knolls Site as well as the results of the Mohawk River water sampling during the second quarter of 1960 are summarized below.

TABLE 4.—GROSS BETA RADIOACTIVITY DISCHARGED AND DETECTED IN THE MOHAWK RIVER (1960)

Period	Total waste discharged millicuries	Average concentrations discharged μμc/liter	Upstream	Downstream		
			GE powerhouse μμc/liter	Vischer Ferry μμc/liter	Cohoes*	
					Raw μμc/liter	Treated μμc/liter
April	282	5,800	4	ND	1	ND
May	80	1,500	1	3	5	ND
June	64	1,800	8	10	4	6
Second quarter	426	3,000	4	4	3	2

*Cohoes samples are weekly samples, therefore they are less representative than the samples collected upstream.

ND—Not detectable.

ENVIRONMENTAL AIRBORNE RADIOACTIVITY

Environmental airborne radioactivity is measured at three locations on the Knolls Site, four locations on the West Milton Site and at the General Electric Company Research Laboratory, approximately one mile west of the Knolls Site. Airborne radioactivity is sampled continuously and analyzed on a weekly basis. Each environmental monitoring station is equipped with film dosimeters to detect integrated gamma radioactivity levels. The averaged results of the airborne radioactivity analyses are given in the following table.

TABLE 5.—GROSS BETA AIRBORNE RADIOACTIVITY*

(Average concentrations in $\mu\mu c/m^3$)

Period 1960	Knolls Site	West Milton	Off-Site
April	0.11	0.19	0.06
May	.07	.15	.14
June	.10	.12	.19
Second quarter	.09	.15	.13

*Measurements of airborne radioactivity are made at least 48 hours after collection to allow the natural-occurring short half-life radioactive material to decay.

SOIL RADIOACTIVITY

Soil samples are collected bi-weekly at two locations, one on the Knoll Site and the other off-site. The off-site location is approximately two miles northeast of the Knolls Site. The sampling location was selected after a four-year study of wind directions at the Knolls Site. This station was upwind of the Knolls Site exhaust stacks 98 percent of the time in the period tested. The results of the beta radioactivity analyses of the soil samples are in the following table.

TABLE 6.—GROSS BETA RADIOACTIVITY IN SOIL SAMPLES (1960)

(Average concentrations in $\mu\mu c/gm$)

Period	Off-site	Knolls Site
April	21	13
May	22	14
June	18	20
Second quarter.....	20	16

CONCLUSION

As a result of the environmental monitoring program conducted by the Knolls Atomic Power Laboratory at both the Knolls Site and the West Milton Site, it is concluded that the operations at these installations did not adversely affect the radioactivity levels of the local environment.

S1C PROTOTYPE REACTOR FACILITY

Combustion Engineering, Inc.
Windsor, Connecticut

September, 1960

Environmental levels of radioactivity at the S1C Prototype Reactor Facility for first quarter of 1960 were reported in the November 1960 issue of the Radiological Health Data. The following report presents a summary of the data for the second quarter of 1960.

The S1C Prototype is a land-based nuclear submarine power plant facility. This facility is operated for the United States Atomic Energy Commission by the Naval Reactors Division of Combustion Engineering, Inc. at Windsor, Connecticut. The Prototype contains a pressurized water type nuclear reactor. It is used to conduct research and development work as well as to train personnel in operation of naval reactor power plants.

Nearly all of the radioactive wastes originate from the activation of minute amounts of impurities and corrosion products in the circulating water used as the reactor coolant. Small quantities of gaseous waste result from the activation of minute amounts of air dissolved in the coolant water.

Liquid Wastes

Approximately 78.6 μc of beta-gamma radioactivity was released during the quarter in 2.6×10^5 gallons of waste effluent and dilution water. The table below is a summary of gross radioactivity released to the Farmington River.

TABLE 1.--SUMMARY OF GROSS RADIOACTIVITY RELEASED TO THE FARMINGTON RIVER

Month 1960	Total for month microcuries	Average per day microcuries	Average concentration released (μμc/liter)
April.....	14.6	0.49	75
May.....	24.0	0.77	73
June	40.0	1.33	89
	78.6		

The Farmington River is sampled monthly at various locations for determination of alpha and beta-gamma activity in river water and mud. The results of this sampling are in table 2.

TABLE 2.--GROSS RADIOACTIVITY OF WATER AND MUD SAMPLES FROM FARMINGTON RIVER

Second quarter 1960

Location	Water samples				Mud samples			
	No. samples	Alpha μμc/liter	Beta Gamma μμc/liter	U ppm	No. samples	Alpha μμc/gram	Beta Gamma μμc/gram	U ppm
Upstream:								
Spoonville Bridge.....	2	24.5	0.23	0.002	2	0.382	1.57	1.24
Above Brook	2	81.0	2.27	.001	2	0.382	2.12	0.86
Outlet:								
Mouth of Brook.....	2	94.2	0.23	.012	2	6.12	2.52	3.25
Downstream:								
Below Brook.....	2	72.7	1.37	ND*	2	0.225	2.77	0.48
Rainbow Dam.....	2	24.2	0.23	ND	0	-	-	-
Windsor Bridge	2	24.2	2.72	ND	2	0.270	2.68	1.16

*Non-detectable.

Table 3 presents a comparison of operational and pre-operational radioactivity levels of water samples from the Farmington River. Column headings, "Pre-operational averages" and "First quarter averages" were inadvertently interchanged in table 3, page 44 of the November 1960 Radiological Health Data, which presented the first summary for the S1C Facility. Second quarter, as well as corrected first quarter and pre-operational sample values are given in the following table.

TABLE 3.--COMPARISON OF OPERATIONAL AND PRE-OPERATIONAL WATER SAMPLES

(Average concentrations in μμc/liter)

Location	Operational				Pre-operational	
	First quarter		Second quarter			
	Alpha	Beta	Alpha	Beta	Alpha	Beta
Upstream.....	35	17	52.2	1.25	55	5.2
Outlet.....	50	4.5	94.2	0.23	54	4.5
Downstream	23	<4.5	40.4	1.44	30	5.6

Fallout

Radioactive fallout is collected on a weekly basis at six locations around the site and analyzed for gross radioactivity. Off-site fallout collections in neighboring towns are also made and analyzed for gross radioactivity and comparisons made as to on and off-site stations.

TABLE 4.--GROSS BETA RADIOACTIVITY IN FALLOUT

(Average quantities in $mc/mi^2/month$)

Location	Second quarter 1960	
	Number samples	Gross beta
Prototype site	53	3.13
Off-site in neighboring towns.....	71	3.07

From the above table it can be seen that fallout on-site and off-site are essentially equal and of very low level. This fallout has been attributed to residual activity from weapons tests rather than from S1C Prototype operations.

Airborne Waste Effluent

Ventilation air from the land-based submarine hull is continuously monitored at the exhaust stack. Table 5 summarizes the data for the second quarter of 1960.

TABLE 5.--AIRBORNE WASTE EFFLUENT RADIOACTIVITY AT EXHAUST STACK

(Average concentrations in $μμc/m^3$)

Periods	Gross beta
April 1960.....	71
May 1960	44
June 1960	47
Second quarter.....	54

Conclusion

Measurements of the radioactivity in the Farmington River, the industrial waste effluent from the plant, air, and fallout in the vicinity of the SIC Prototype during the second quarter of 1960 showed no significant contribution of radioactivity from the Prototype to the environment.

SHIPPINGPORT ATOMIC POWER STATION

Duquesne Light Company
Beaver County, Pennsylvania

September 1, 1960

Environmental levels of radioactivity at the Shippingport Atomic Power Station for 1959 and first quarter of 1960 were reported respectively in July and December 1960, Radiological Health Data. The following report presents a summary of the data for the second quarter of 1960.

The Shippingport Atomic Power Station is the first large scale nuclear powered electric generating station, operated for the Atomic Energy Commission by the Duquesne Light Company. The plant was returned to operation in May 1960 after being shutdown nearly six months for the replacement of a portion of the fuel.

Liquid Radioactive Waste

The limits for discharge of radioactive wastes at Shippingport are based on criteria which depend on a knowledge of the radioactive materials which make up the waste and on recommended standards for unidentified mixtures of radioactive isotopes. If the quantity of a particular radioactive isotope is known, the discharge of that particular isotope may be based on the limit for that individual material. If the quantities of specific radioactive isotopes are not identified, then a more stringent limit for gross unknown mixtures of radioactive material is used. At Shippingport, most of the wastes are discharged according to the limit for gross unidentified mixtures of radioactivity. This is now done because total quantity of radioactivity in the waste is low and analyses for many specific radioactive isotopes are laborious and expensive. However, the discharge of a known lower hazard radioactive isotope called tritium is controlled separately, based on its own limit, since its formation in the reactor plant can be predicted with relative ease.

The waste discharge criteria for the plant imposes the restriction that radioactivity released to the environment does not increase the background radioactivity levels by more than 10 percent of the permissible concentrations recommended by the NCRP. This factor of 10 percent of the NCRP recommended permissible concentrations is usually applied to areas outside an atomic energy installation. At Shippingport, this criterion is applied to the actual plant discharges and no allowance is made for the dilution available in the environment except for that river water actually pumped through the plant for cooling the condensers.

The liquid effluent from the plant radioactive waste disposal system is carefully monitored before, during, and after release to the Ohio River to insure that excessive quantities of radioactive materials are not sent to the environment.

The liquid radioactive wastes discharged during the second quarter of 1960 are summarized below. The average concentrations of gross radioactivity shown in the table are in addition to normal background radioactivity in the condenser cooling water used for dilution in the effluent channel prior to discharge to the Ohio River.

TABLE 1.—SUMMARY OF GROSS RADIOACTIVITY RELEASED TO THE OHIO RIVER

Month	Total for month μc	Average per day μc	Average concentration in effluent channel during release μμc/liter
1960:			
April	48,793	1,630	6.2
May	10,949	354	2.9
June	11,830	394	2.4
1/10 MPC*	-	-	10

*One-tenth of the maximum permissible concentration in drinking water adapted from NBS Handbook 69, table 3.

The maximum total discharge in one day during the quarter was 3,737 microcuries. Tritium releases to the Ohio River are presented in the following table.

TABLE 2.—SUMMARY OF TRITIUM RELEASED TO THE OHIO RIVER

Month	Total for month curies	Average per day curies	Average concentration in effluent channel during release μμc/liter
1960:			
April	0	-	-
May	0.866	0.028	900
June	2.264	.075	1,300
1/10 MPC*	-	-	3×10^6

*One-tenth of the maximum permissible concentration in drinking water from table 1, NBS Handbook 69.

River water samples are taken continuously at four locations upstream and downstream from Shippingport and analyzed weekly. These locations are numbered and are marked as triangles on the attached map. Upstream sampling stations are located at Phillips Power Station (No. 1) of the Duquesne Light Company (about 20 miles upstream) and at the condenser cooling water intake at Shippingport (No. 2). The downstream continuous sampling stations are on the water intake lines of the water treatment plants at Midland, Pennsylvania (No. 4), and East Liverpool, Ohio (No. 5), approximately one and eight miles downstream respectively. Weekly grab samples were also collected during the quarter from the River at Dam No. 7, which is station No. 3 on the attached map. Grab samples were also collected in the effluent channel, and in the condenser cooling water intake and divided with Pennsylvania Department of Health representatives for duplicate analysis. The results of these duplicate grab samples are included with the river monitoring data below for comparison purposes.

TABLE 3.--GROSS RADIOACTIVITY CONCENTRATIONS IN THE OHIO RIVER DURING SECOND QUARTER 1960

(Average concentrations in μμc/liter)

Station	No. Samples	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
Upstream:							
Phillips	13	3.3	4.9	8.2	0.4	0.3	0.7
Shippingport Intake	13	3.9	5.0	8.9	.6	.6	1.2
Downstream:							
Midland	13	3.5	5.3	8.8	.5	.3	0.8
E. Liverpool	13	3.3	5.7	9.0	.5	.5	1.0
Dam No. 7*	13	3.8	6.0	9.8	.6	.3	0.9
Special Samples:**							
Effluent Channel	12	5.3	4.5	9.8	1.0	.5	1.5
Intake	12	5.2	4.0	9.2	1.0	.2	0.8

*Grab sample.
**Duplicate samples collected by Pennsylvania Department of Health.

The liquid radioactive wastes discharged from the Shippingport plant during the second quarter of 1960 have not shown a detectable effect on the background radioactivity level of the Ohio River.

Area Monitoring

Four area monitoring stations continuously monitored and recorded background levels of beta-gamma radiation and airborne particulate radioactivity in the Shippingport vicinity. These stations appear in figure 1 as circles with the station number inscribed. The data recorded by each station during this quarter was checked and tabulated weekly. Locations of the stations are identical to those reported in the last quarterly report.

The plant incinerator used for burning contaminated combustible material was operated only once during the quarter. The exhaust from the incinerator passes through a wet gas scrubber and a filter and is monitored at the stack exit during operation to determine the quantity of particulate radioactivity discharged. During this one day's operation, the particulate radioactivity monitored was 11 $\mu\mu c/m^3$ which is less than the permissible concentration for unidentified radioisotopes in air of 100 $\mu\mu c/m^3$ as recommended by the NCRP in NBS Handbook 69, table 4.

The data reported below are the results of measurements made only one hour after sample collection and therefore natural radon activity would be included. The average concentration of particulate radioactivity in the atmosphere during the second quarter of 1960 was found to be well below the maximum permissible concentration recommended by the NCRP.

TABLE 4.--AIRBORNE PARTICULATE RADIOACTIVITY

(Average concentrations in $\mu\mu c/m^3$)

Period	Station			
	SE of Main Building	1/2 mi. SW of Site	1/2 mi. NW of Site	1/2 mi. NE of Site
Second quarter 1960	1.1	1.1	1.3	1.5

TABLE 5.--GROSS BETA-GAMMA BACKGROUND RADIATION LEVELS

(Average values in millirad/hour)

Period	Station			
	SE of Main Building	1/2 mi. SW of Site	1/2 mi. NW of Site	1/2 mi. NE of Site
Second quarter 1960	0.016	0.014	0.013	0.012

Fallout

Radioactive fallout is collected at the four area monitoring stations. Samples are picked up weekly for analyses of gross beta radioactivity. The data for the second quarter are presented below.

TABLE 6.--GROSS BETA RADIOACTIVITY IN FALLOUT DURING SECOND QUARTER 1960

(Average concentrations in $mc/mi^2/mo$)

Station	Number samples	Activity
Upwind		
1/2 mi. SW of Site	13	10.6
1/2 mi. NW of Site.....	13	12.4
Downwind		
SE of Main Building.....	13	11.9
1/2 mi. NE of Site	13	16.0

The prevailing wind direction at Shippingport is generally from West to East. Data from the upwind stations are compared with that from the downwind stations. The results do not indicate that the plant contributes any fallout to the surrounding area.

Soil Sampling

Soil samples were collected from twenty locations within a radius of approximately five miles of the Shippingport Site during the first quarter of 1960. Since the analyses were not complete in time for the first quarter report they are being included here.

TABLE 7.--GROSS RADIOACTIVITY IN SOIL SAMPLES

(Average concentrations in $\mu\mu c/gm$)

Period	Activity	
	Alpha	Beta
Pre-operational 1956-57	15.4	15.8
Calendar year 1959.....	17.5	18.0
First quarter 1960	17.5	15.1

General Conclusion

As a result of the environmental monitoring program conducted by the Shippingport Atomic Power Station, it is concluded that the operations at this station did not adversely affect the radioactivity levels of the local environment.

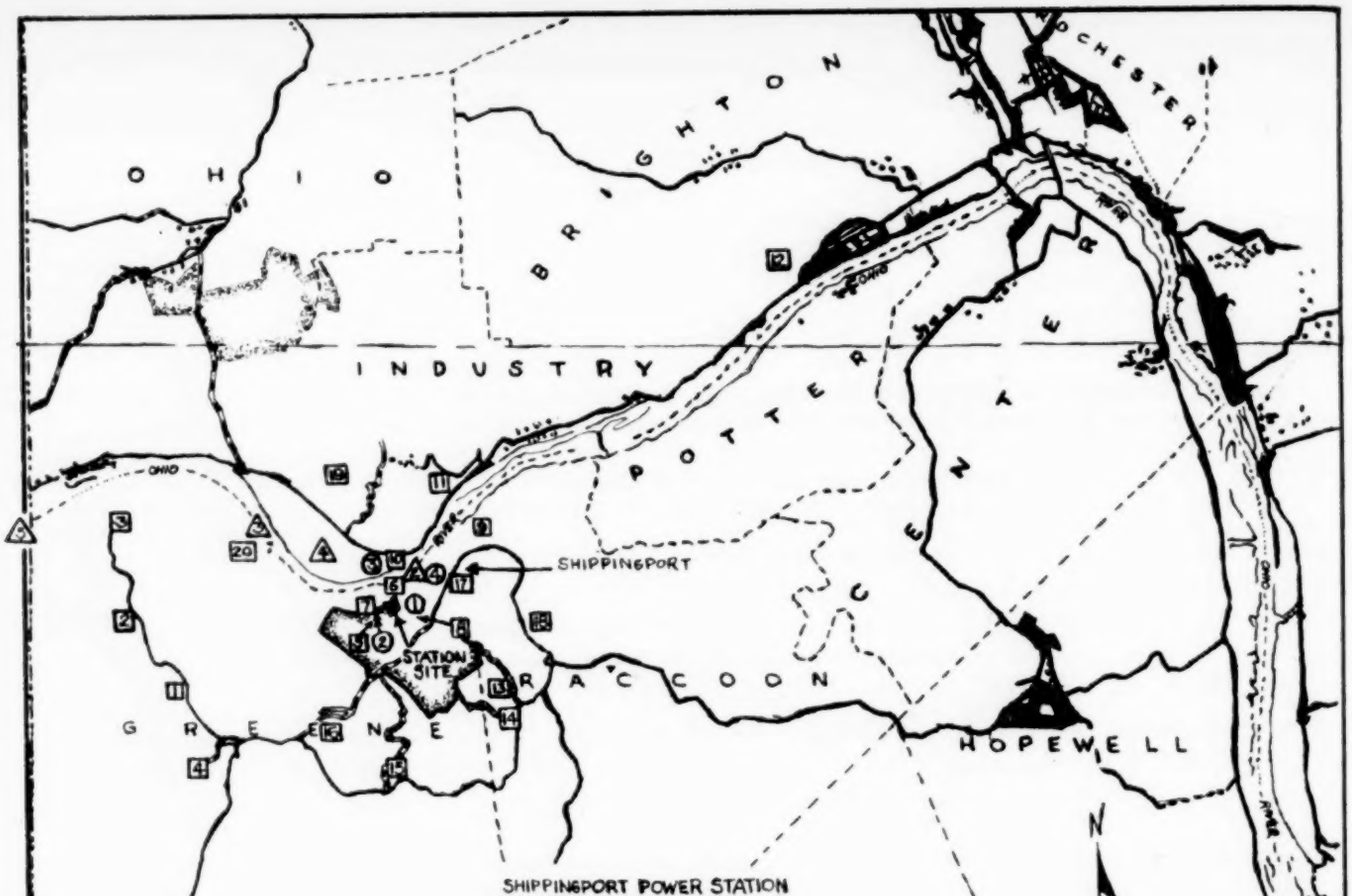

FIGURE 1

FALLOUT STUDIES INTERPRETIVE REPORTS

U. S. Atomic Energy Commission

As a part of a cooperative arrangement with the AEC, the U. S. Weather Bureau has continued to analyze and interpret atmospheric fallout data. Several interpretive reports and notes resulting from such studies have been issued recently. These may be found in the AEC Health and Safety Laboratory Fallout Program Quarterly Summary Report, HASL-95, October 1, 1960. They are as follows:

1. L. Machta, "An Attempt to Compute Relative Removal Rates from the Polar and Temperate Latitude Stratosphere in the Spring of 1959".

2. N. Murayama and L. Machta, "Cs^{137}/Sr^{90} Ratios in the Stratosphere Ash Can Flights". "Ash Can" refers to the stratospheric balloon sampling program.

3. K. Telegadas, "Global Integrals of Monthly Sr^{90} Fallout, June-November 1959". This is a continuation of a similar report which appeared in HASL-84, April 1, 1960.

4. K. Telegadas and N. Murayama, "An Estimate of the Material Balance of Sr^{90} from the October 1958 USSR Series for the Period December 1958-November 1959".

Studies of fallout deposition data are also made by the AEC Health and Safety Laboratory in New York. A report is reproduced below on tungsten-185 deposition and its relationship to fallout from the U. S. weapons test series (HARDTACK I) in 1958 in the Pacific. This report also appears in HASL-95, pages 203-207. The U. S. Naval Research Laboratory has conducted a similar study. This was reported in Science 132, No. 3420, July 15, 1960.

TUNGSTEN-185 DEPOSITION ON THE EARTH'S SURFACE

Edward P. Hardy

Health and Safety Laboratory
U. S. Atomic Energy Commission

"During the 1958 Hardtack nuclear test series conducted by the United States in the Pacific, tungsten-185 was produced in some of the weapons tested. The presence of this radioactive nuclide of tungsten in the debris resulting from the testing, had made it possible to trace the radioactive fallout which resulted from this particular series of detonations. Tungsten-185 has been assayed in the monthly pot and funnel ion-exchange column collectors. A network of sampling stations is located throughout the world.

"In order to study the latitudinal distribution of tungsten-185 fallout, the monthly results have been averaged over quarterly periods of time and by twenty degree latitude bands as shown in figure 1. In this plot, the tungsten-185 values have been extrapolated to the midpoint of the sampling month. (This nuclide decays with a half-life of 75.8 days). The highest measured levels were detected in the northern hemisphere during the third quarter of 1958 and lesser but significant amounts were measured in the southern hemisphere during the same period of time. By the last quarter of 1958 and the first quarter of 1959, the measured levels of tungsten-185 had fallen off in the northern hemisphere and were closer to the levels detected in the southern hemisphere. The southern hemisphere values as measured each month did not show the marked drop that was evidenced in the northern hemisphere.

"In figure 2 the total megacuries of deposited tungsten-185 for all latitude bands which include sampling stations, have been plotted monthly. In this case the tungsten-185 values have been extrapolated to June 1, 1958. The graph shows that the actual arrival time, on a global basis, for the peak deposition of the Hardtack debris took place during March and April 1959. This may be evidence of a meteorological spring rise in the northern hemisphere since the Hardtack tests took place between May and August of 1958. This conclusion is also suggested from a consideration of the strontium-90 and strontium-89 data. Integration of this curve yields a figure of 100 megacuries of tungsten-185 as the total amount measured by the pot and ion-exchange column network for the period August 1958 through December 1959.

"Table 1 lists the strontium-90 and tungsten-185 concentrations in global fallout by quarters for 1958 and 1959. The tungsten-185 values have again been extrapolated to 6-1-58. By assuming a W^{185} Sr^{90} ratio of 360 at 6-1-58, it is possible to estimate the Hardtack strontium-90 contribution to each quarterly period. When this calculated amount of strontium-90 is subtracted from the total measured, a value for the remaining or residual strontium-90 is obtained. The last column of the table is the calculated percent of the Hardtack contribution to the total fallout measured. Since tungsten-185 measurements were not carried out on a global basis until August 1958, the value for the third quarter of 1958 may be low.

"The percent Hardtack contributions for the fourth quarter of 1958 and the four quarters of 1959 (on a global basis), appear to be fairly constant and average to about 20 percent. When the quarterly percent Hardtack contribution is calculated for the northern and southern hemispheres separately, the values are reasonably constant for the northern hemisphere but quite variable for the southern hemisphere. In the northern hemisphere during 1959 it appears that 80 percent of the fallout was due to weapons testing other than the Hardtack series. During the first quarter of 1959 in the southern hemisphere, the fallout was composed of Hardtack debris, debris from earlier 1958 testing, plus a presumably small contribution from the United Kingdom testing in September 1958. By the second quarter of 1959 in the southern hemisphere, most of the fallout appears to have been from Hardtack but in the third and fourth quarters, the Hardtack contribution falls off significantly. This may be an indication that debris from the fall 1958 Soviet tests had begun to deposit in the southern hemisphere during this last half of 1959. The strontium-89 to strontium-90 ratios indicated that fallout of a more recent origin was occurring in the southern hemisphere during this same time period."

Figure 1 DEPOSITION OF TUNGSTEN–185 BY 20° LATITUDE BANDS

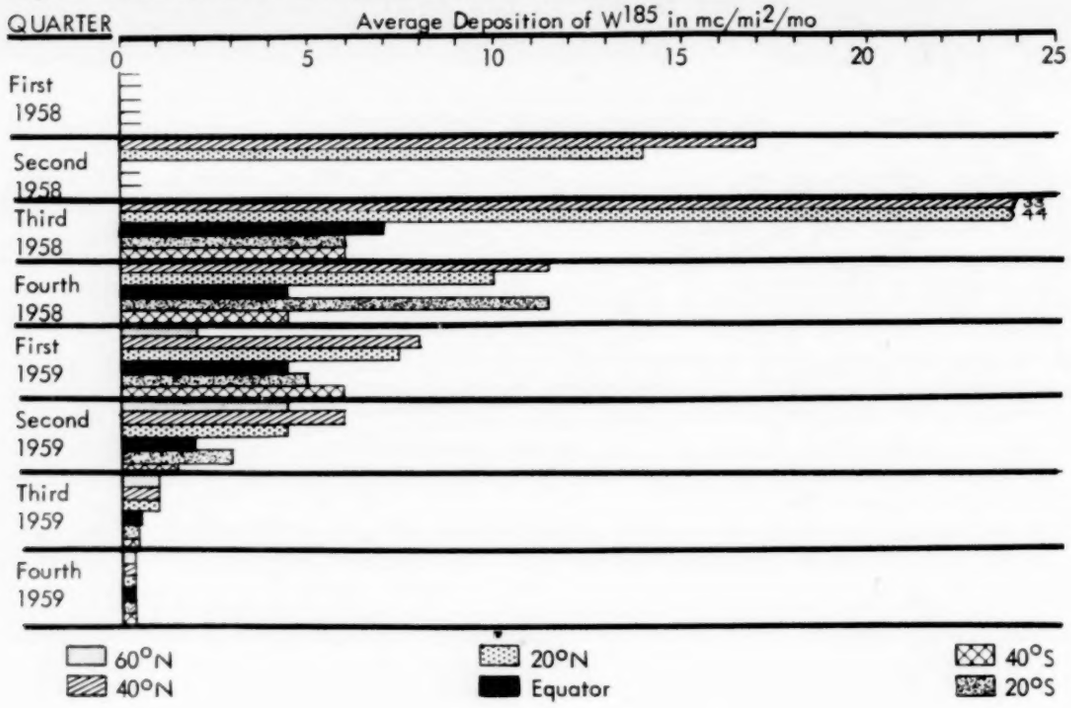

Figure 2 WORLD–WIDE DEPOSITION OF TUNGSTEN–185

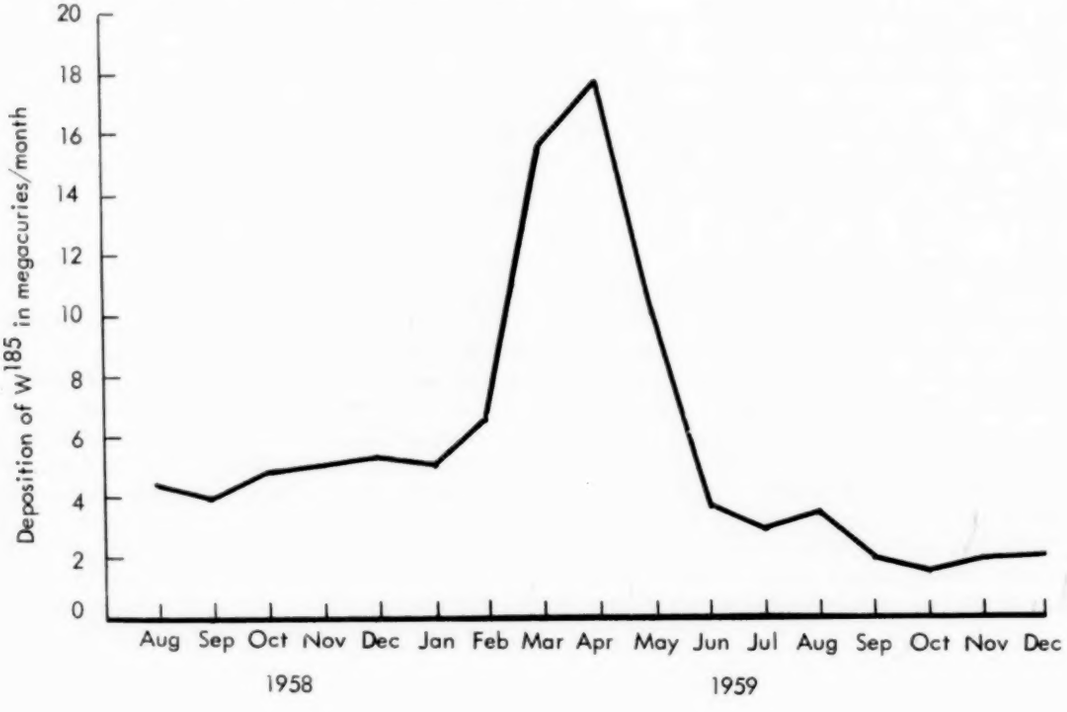

TABLE 1.—CALCULATED CONTRIBUTION OF HARDTACK FALLOUT TO TOTAL MEASURED

(Megacuries)

Period	Total Sr^{90} [1]	Total W^{185} [2]	Hardtack Sr^{90} [3]	Residual Sr^{90}	Percent hardtack debris
	Northern and Southern Hemisphere				
1958:					
First quarter	0.14				
Second quarter	0.24				
Third quarter	0.18	[4]8.4	[4]0.023	0.16	[4]13
Fourth quarter	0.21	15	0.042	0.17	20
Total	0.77	23.4	0.065	0.33	
	Northern Hemisphere				
1959:					
First quarter	0.36	18	0.050		14
Second quarter	0.41	22	0.062		15
Third quarter	0.12	9.0	0.025		22
Fourth quarter	0.04	2.9	0.008		19
Total	0.93	51.9	0.145		
	Southern Hemisphere				
First quarter	0.066	11	0.031		47
Second quarter	0.025	8.6	0.024		96
Third quarter	0.025	2.9	0.008		32
Fourth quarter	0.033	2.2	0.006		18
Total	0.149	24.7	0.069		
	Northern and Southern Hemisphere				
First quarter	0.43	29	0.081	0.35	19
Second quarter	0.43	30	0.086	0.34	20
Third quarter	0.14	12	0.033	0.11	24
Fourth quarter	0.08	5.6	0.014	0.06	19
Total	1.08	76.6	0.214	0.86	
Total--1958 and 1959	1.85	100	0.279	1.19	

[1]Based on HASL pot and funnel data.
[2]Based on HASL pot and funnel data (W^{185} extrapolated to 6-1-58).
[3]Calculated assuming $W^{185}/Sr^{90} = 360$ at 6-1-58.
[4]Estimate is low since global sampling did not begin until August 1958.

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